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(Recognosce notum, ignotum inspice)

TRANSACTIONS

Edited by

J. RAMSBOTTOM, B. BARNES and H. WORMALD

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FUNGUS FORAY, EPPING FOREST

4 October 1941

By J. RAMSBOTTOM

MORE as a token of continued activity than as a serious attempt at field work, a day's foray was held in Epping Forest on Saturday, 4 October 1941. About thirty members and friends met at Chingford, which is conveniently situated for entering the Forest. The season earlier had been exceptionally good, and later there had been a spell of fine dry weather and toadstools were not abundant. As is almost usual when fungi are scarce on account of drought, rain soon made its appearance, but after a heavy shower the weather cleared. The path taken was first into the forest, the edge being then skirted until Fairmead was reached, and thence through the best collecting ground to High Beech. From here a number of the party left; the remainder arranged to have tea and afterwards most walked back to Chingford.

A look-out was kept for *Ecchyna* [*Pilacre*] *Petersii*, which can usually be found on the old hornbeams at Chingford, but without success. Two somewhat weathered specimens of what almost exactly resembled the illustrations of *Amanita Eliae* Quél., in *Bull. Soc. myc. Fr.* XLVI (1930), Atlas, Pl. xxxvi, were collected, but on microscopic examination were found to have the structure of *Amanitopsis fulva*. A tuft of *Hypholoma fasciculare* was found with perfectly yellow gills—the *Clitocybe Sadleri* of Berkeley (Cooke, *Illustr.* 127 [180]): the form is not uncommon when the fungus occurs at the base of wooden palings which are fixed in pavement. As usual, when examined microscopically, it showed a few typical spores. Near High Beech a number of specimens of *Collybia cirrhata* occurred. Cultures made from these by Miss Stephens have produced typically coloured sclerotia but of much larger dimensions than usual in the field. The best find of the day was *Russula solaris* Ferd. & Wing. This species is probably not as rare as would seem from its records. When every *Russula* with a yellow cap is named *R. ochroleuca*, and with masses of that species about, *R. solaris* is likely to be overlooked. In the young stage the cap has the shape and the pectinate edge of *R. foetens*, but it is a smaller fungus and has a bright yellow cap; it is possibly the citron yellow form of *R. pectinata* mentioned by Ricken. Continental mycologists have busied themselves these many years in trying to straighten out the genus *Russula*. It is an interesting commentary on the state of our knowledge that *R. solaris* has been suggested by different workers to

be synonymous with *R. Raoultii* Quél., *R. farinipes* Rom., *R. Queletii* Fr. f. *albocitrina* Barb., *R. aurantiolutea* Kauff., *R. disparilis* Burl., *R. constans* Karst., and *R. citrina* Gill.

Everywhere in the forest decaying specimens, particularly of *Lactarius*, were covered with growths of *Penicillium*. Mr G. Smith later reported that he had isolated two species, *P. brevi-compactum* Dierckx (*P. stolonifera* Thom) and *P. cyclopium* Westl.

The list of fungi is small. The President made note of those met with by his party, but all members present added their share. As was to be expected the opportunity for discussing mycology and the affairs of friends present did not allow the paucity of fungi to spoil a very pleasant day.

The list is arranged alphabetically, as has been recently adopted:

HYMENOMYCETES AND GASTEROMYCETES

Amanita mappa (Batsch) Fr., muscaria (Linn.) Fr., rubescens (Pers.) Fr.
Amanitopsis fulva (Schaeff.) W. G. Sm.
Androsaceus androsaceus (Linn.) Pat., rotula (Scop.) Pat.
Armillaria mellea (Vahl) Fr., mucida (Schrad.) Fr.
Boletus badius Fr., chrysenteron (Bull.) Fr., luridus (Schaeff.) Fr., subtomentosus (Linn.) Fr.
Calocera stricta Fr.
Clavaria cinerea (Bull.) Fr., cristata (Holmsk.) Fr., inaequalis (Müll.) Fr.
Clitocybe aurantiaca (Wulf.) Stud., clavipes (Pers.) Fr., infundibuliformis (Schaeff.) Fr.
Collybia butyracea (Bull.) Fr., cirrhata (Schum.) Fr., fusipes (Bull.) Fr., maculata (A. & S.) Fr., radicata (Rehl.) Berk.
Coprinus micaceus (Bull.) Fr., niveus (Pers.) Fr., plicatilis (Curt.) Fr.
Cortinarius (Dermocybe) caninus Fr., (Telamonia) hemitrichus (Pers.) Fr., (Dermocybe) sanguineus (Wulf.) Fr.
Fistulina hepatica (Huds.) Fr.
Flammula sapinea Fr.
Galera hypnorum (Schrank) Fr., tenera (Schaeff.) Fr.
Ganoderma applanatum (Pers.) Pat.
Hypholoma fasciculare (Huds.) Fr., hydrophilum (Bull.) Fr., lacrymabundum Fr.
Inocybe eutheles B. & Br., geophylla (Sow.) Fr.
Irpex obliquus (Schrad.) Fr.
Laccaria laccata (Scop.) B. & Br., var. amethystina (Vaill.) B. & Br.
Lactarius blennius Fr., mitissimus Fr., serifluus (DC.) Fr., subdulcis (Pers.) Fr., turpis (Weinm.) Fr., quietus Fr.
Marasmius dryophilus (Bull.) Karst., hariolorum (DC.) Quél., oreades (Bolt.) Fr., peronatus (Bolt.) Fr.
Mycena galericulata (Scop.) Fr., galopus (Pers.) Fr., inclinata Fr., polygramma (Bull.) Fr., rugosa Fr.
Nolanea pascua (Pers.) Fr.
Panaeolus campanulatus (Linn.) Fr.
Paxillus involutus (Batsch) Fr.
Phlebia merismoides Fr.
Pholiota squarrosa (Müll.) Fr.
Pleurotus corticatus Fr.
Pluteus cervinus (Schaeff.) Fr.
Polyporus adustus (Willd.) Fr., betulinus (Bull.) Fr., radiatus (Sow.) Fr.
Polystictus versicolor (Linn.) Fr.

Psathyra pennata Fr.
Psilocybe ericaea (Pers.) Fr., semilanceata Fr.
Russula alutacea (Pers.) Fr., atropurpurea Krombh., fragilis (Pers.) Fr., mustelina Fr., nigricans (Bull.) Fr., ochroleuca (Pers.) Fr., solaris Ferd. & Wing.
Scleroderma verrucosum (Vaill.) Pers.
Stereum hirsutum (Willd.) Fr.
Stropharia aeruginosa (Curt.) Fr., semiglobata (Batsch) Fr., squamosa (Pers.) Fr.
Tricholoma albobrunneum (Pers.) Fr., fulvum (DC.) Fr., saponaceum Fr., sejunctum (Sow.) Fr.
Tubaria furfuracea (Pers.) W. G. Sm.

UREDINALES

Melampsoridium betulinum (Pers.) Kleb.
Phragmidium violaceum (Schultz.) Wint.
Puccinia Cirsii Lasch., Violae (Schum.) DC.

USTILAGINALES

Ustilago Scabiosae (Sow.) Wint.

PYRENOMYCETES

Diatrype stigma (Hoff.) Fr.
Diatrypella quercina (Pers.) Cke.
Hypoxylon coccineum Bull.
Melanconis stilbostoma (Fr.) Tul.
Nectria cinnabarina (Tode) Fr.
Sphaerotheca pannosa (Wallr.) Lév.
Stigmatea Robertiani Fr.
Xylaria Hypoxylon (Linn.) Grev.

DISCOMYCETES

Bulgaria inquinans Pers.
Dasyobolus immersus (Pers.) Sacc.
Dasyscypha virginea (Batsch) Fuck.
Helotium herbarum (Pers.) Fr.
Mollisia cinerea (Batsch) Karst.
Orbilia xanthostigma Fr.
Saccobolus violascens Boud.
Stegia Ilicis Fr.

DEUTEROMYCETES

Actinonema Rosae (Lib.) Fr.
Bispora monilioides Cda.
Botrytis cinerea Pers.
Dilophospora Alopecuri Fr.
Penicillium brevi-compactum Dierckx, cyclopium Westl.
Sepedonium chrysospermum (Bull.) Fr.
Septoria Rubi Westend.
Stilbella erythrocephala (Ditm.) Fr.

ANNUAL GENERAL MEETING

13 December 1941

THE Annual General Meeting was held in the rooms of the Linnean Society of London, Burlington House, Piccadilly, at 12 o'clock on Saturday, 13 December 1941, with the President, W. C. Moore, Esq., M.A., in the Chair.

Arising out of the Minutes, the General Secretary gave an outline of the year's programme which had been carried out.

In presenting the Treasurer's Statement, Mr A. A. Pearson said that the general financial position was very good and there was nothing to fear so long as there was no change for the worse in international money matters.

The name of Miss E. M. Blackwell was put from the Chair as the Council's nominee for the Presidency for 1942, and she was elected unanimously. In accordance with Rule 6, the retiring President, Mr W. C. Moore, and his predecessor in office, Dr H. Wormald, were elected Vice-Presidents, and Mr W. Buddin as the third Vice-President.

Mr J. Ramsbottom and Mr A. A. Pearson having consented to continue in office they were again re-elected as General Secretary and Treasurer respectively.

Dr C. G. C. Chesters announced that as he was not at present able to devote the necessary time to the affairs of the Society, he wished to tender his resignation. The President expressed the thanks the Society owed to Dr Chesters for the work he had done during the past five years, and the General Secretary said that, until overburdened with A.R.P. and other duties, Dr Chesters had been energetic in the affairs of the Society and an admirable colleague in every way; he hoped that in brighter days he would return to office. The meeting showed its appreciation of Dr Chesters's services.

The President then put forward the name of Dr G. C. Ainsworth as Secretary for 1942, and this was carried unanimously.

Mr J. Ramsbottom, Dr B. Barnes and Dr H. Wormald were re-elected as Editors. As members of Council, Mr S. D. Garrett, Dr A. Smith, Mr G. Smith and Mrs E. W. Mason were elected in place of the retiring members, Dr M. Brett, Miss M. W. Rea, Miss F. L. Stephens and Miss E. M. Blackwell, Miss Blackwell as President being *ex officio* a member of Council.

The Plant Pathology Committee nominated Dr G. R. Bisby, Mr M. H. Moore and Dr J. H. Western to replace the retiring members, Messrs R. V. Harris, E. W. Mason and Miss E. M. Wakefield; this was agreed.

The President then proposed from the Chair that Miss E. M. Wakefield and Mr T. Petch be elected Honorary Members. Miss Wakefield had served as Secretary for many years, and both were well qualified under both headings mentioned in the Rules, 'Honorary Members shall be persons of pre-eminence in Mycology, or who have rendered special service to the Society.' The proposal was received with acclamation.

The General Secretary then explained the suggestions for the 1942 programme. It would probably be possible to hold at least three meetings for the reading of papers, two in the spring and one in the autumn, and one or more day forays in the autumn or possibly a week-end one. The Annual Meeting would best be fixed for 12 December 1942.

It was decided that, generally speaking, Saturday was the most suitable day for indoor meetings.

The meeting then adjourned until 2 p.m. when the President delivered his Address on 'Organization for Plant Pathology in England and Wales—Retrospect and Prospect'.

Following the Address, Mr Ramsbottom thanked the President for his stimulating remarks and paid tribute to the services Mr Moore had given to the Society both before and particularly during his term of office. He knew that the President thought some of his remarks controversial and it might be profitable to discuss these when members had had an opportunity to read them at leisure. Doubtless before long much would have to be readjusted, and it was desirable that mycologists should be ready to make the most of changed circumstances. As a Society their object was the furtherance of the study of mycology in all its branches. In asking that the meeting should thank the Linnean Society for its continued hospitality he said that it was appropriate that they should bask in the benevolent regard as it were of that great mycologist and pathologist the Rev. M. J. Berkeley.*

At the Council meeting it was decided that except in special circumstances, titles only shall be published in the *Transactions* of papers read at meetings, when the full paper has appeared or is shortly to appear. Summaries of papers given at the meetings are not to contain more than 250 words.

J. Ramsbottom

* In the Meeting Room of the Linnean Society there is a portrait of Berkeley by John Peel, presented by subscribers in 1878, when Berkeley was seventy-five.

RECEIPTS AND PAYMENTS FOR THE YEAR ENDING 30 JUNE 1941

1940	£	s.	d.
1 July—Balance brought forward	603	7	10
2 July—Grant from Agricultural Research Council for Monograph of Diseases of British Grasses	50	0	0
1941			
30 June—Subscriptions to date	250	9	0
Gifts to Printing Fund	3	1	9
Sale of *Transactions*:			
Current Vols.	102	6	0
Back Vols.	76	0	7
Sale of Reprints	8	11	6
Profit from Sale of C. Rea's *British Basidiomycetae*	4	15	11
Deposit Interest	2	14	10
War Loan Interest	17	10	0
	£1118	17	5

1941	£	s.	d.
30 June—Cambridge University Press, Cost of Vol. XXIV, *Transactions* and Reprints ...	529	4	8
Postage, etc.			
Treasurer	2	10	0
Secretary		10	0
Sec. Pathological Committee	2	10	3
Editor	2	9	1
Sundry Printing	11	16	0
Fees of Meetings		10	0
Purchase of *Transactions*	1	10	0
Subscriptions refunded	3	3	0
Balance in hand and on deposit	564	14	5
	£1118	17	5

CAPITAL ACCOUNT—Robinson Bequest, £50; Cheesman Fund, £150; Printing Fund, £300 } invested in 3½% War Loan

A. A. PEARSON, *Hon. Treasurer*

Examined and found correct, F. G. GOULD

PRESIDENTIAL ADDRESS

ORGANIZATION FOR PLANT PATHOLOGY IN ENGLAND AND WALES—RETROSPECT AND PROSPECT

By W. C. MOORE, M.A.

The term Plant Pathology ought to be applied to a subject the study of which should include any derangement of the plant, whether of vegetable, animal or mineral origin. Unfortunately it has been used very loosely, and for many years past has often been regarded as having a purely botanical connotation, and as synonymous with what is vaguely called economic mycology. Most emphasis will not unnaturally be given in this address to plant pathology in its mycological aspects, and no attempt will be made to avoid using the customary terminology of the subject, but it is not my intention to deal with mycology in its strict and literal meaning. On the other hand, I must confess to employing the terms plant pathology and plant pathologist in the narrowest as well as the broadest sense, but I hope without confusing the issue.

I suspect that most of you will wish to question at least some of what I shall have to say, but I doubt if anyone will dispute the claim that the Rev. Miles Joseph Berkeley was the father of plant pathology in Great Britain, just as he was the founder of mycology here. He was a contemporary of Unger and so grew up during the period when fungi were regarded as entophytes originating from diseased host tissues. It is all the more remarkable, therefore, that he shared with Kühn and de Bary, who were more than twenty years his juniors, the leadership of a new school of thought which appreciated and taught the true nature and function of parasitic organisms. Berkeley's articles on vegetable pathology, begun in the *Gardeners' Chronicle* in 1854, and continued at intervals in serial form until 1857, set forth his ideas and those of the day in simple language. He still classified diseases by the old method into 'genera' according to symptoms, but his contributions were always to the point and were addressed in the main to the practical man. There were over 170 of the articles altogether, and it is a great pity they were never published separately. Maybe it is still not too late to do so, for they have a considerable historical importance, and would find a worthy place alongside the Phytopathological Classics issued in recent years by the American Phytopathological Society. Nowadays, Berkeley's articles have their

counterpart in the leaflets on plant diseases issued by the Ministry of Agriculture and Fisheries and other bodies. As pointed out in the presentation address when he received the Medal of the Royal Society in 1863, Berkeley was at the time the one and only English authority on vegetable pathology.

M. C. Cooke was twenty-two years younger than Berkeley, and was first and foremost a mycologist, but he, too, left his mark on plant pathology. One of his duties on being placed in charge of the Lower Cryptogams at Kew in 1880 was to report on questions about plant diseases submitted to Kew. Moreover, among the many books and pamphlets he published, his *Fungoid Pests of Cultivated Plants*, first published in parts in the *Journal of the Royal Horticultural Society* and issued as a book in 1906, is still indispensable to plant pathologists seeking information about British diseases of ornamental garden plants. Nevertheless, it was the third of the outstanding older men, the well-known botanical artist Worthington G. Smith, who provided English students with their first general book on plant diseases. His *Diseases of Field and Garden Crops* appeared in 1884. It was based on a series of addresses delivered at the British Museum (Natural History) at the request of the Institute of Agriculture and was rather limited in scope, but it served a very useful purpose.

Two other names, H. Marshall Ward and George Massee, will always be associated with English plant pathology in the latter part of the nineteenth and the beginning of the twentieth centuries. Indeed, Marshall Ward has been named the greatest of English plant pathologists. His outlook was determined by the experience he gained, first as a student under Sachs and de Bary, and later as an investigator of the Rust that decimated the coffee plantations of Ceylon in the late seventies, and, with Sorauer, he became the leading predispositionist of the period. Ward's studies in parasitism, carried out before and after his appointment as Professor of Botany at Cambridge in 1895, have been claimed to have formed the basis of all later investigations into the nature of susceptibility and immunity in plants.

For many years Massee was essentially a mycologist, but after 1893, when he succeeded Cooke in charge of the Lower Cryptogams at Kew, he turned more and more to pathological work. His *Text Book of Plant Diseases* became a landmark in the history of the subject in this country. It was first published in 1899 and passed through several editions during the thirty years or so it retained its place.* Massee formed a link between the older generation who relied on external morphology and the modern school with its advantages of refined technique and methods of pure culture, and in assessing the merits of his work, due allowance must be made for the rapid advances that

* In 1910 it was expanded and reissued under the title *Diseases of Cultivated Plants and Trees.*

were constantly being made in pure culture work. Massee also acted as adviser in plant diseases to the Board of Agriculture. There was then no official phytopathological service, and it is perhaps no exaggeration to say that before 1900, plant pathology in this country was served, in the main, through the zealous diversions of a clergyman and an artist, the predilection of a professor of botany, and the native appetite of a mycologist or two.

This state of affairs in general continued for some years into the twentieth century, but already the beginnings of a new order of things were becoming apparent in the intensive studies of fruit-tree diseases begun when E. S. Salmon migrated from Kew to Wye in 1906. Nevertheless, it was the passing of two Acts of Parliament, one in 1907 and one in 1909, that provided the greatest stimulus to the development of plant pathology in England and Wales.

The first of these was known as the Destructive Insects and Pests Act of 1907. Long before this, under the Destructive Insects Act of 1887, Parliament had empowered first the Privy Council, and later the Board of Agriculture, to issue such Orders as were necessary to keep the Colorado Beetle out of the country. The new Act extended the powers of the Board of Agriculture by enabling it to deal with insect pests other than Colorado Beetle, as well as with fungus diseases of crops, trees and bushes. A small staff of inspectors was created to administer the practical working of the Act, and in 1913 J. C. F. Fryer was appointed to the new post of Entomologist to the Board. For the time being there was no corresponding mycological appointment, guidance on matters relating to plant diseases still being obtained from Kew.

The second Act was called the Development and Road Improvement Funds Act of 1909. As a matter of general policy it was decided that the funds rendered available for aiding agriculture under this Act should be used in the main to subsidize existing or newly founded scientific institutions for two purposes, namely, to carry out research into various branches of agricultural science, and to develop advisory work and local investigations within certain comparatively large areas or provinces. The organization envisaged under this scheme gradually took shape between 1909 and 1914. For the recruitment of personnel for the service a system of research scholarships was introduced, and later, in 1920, a scheme of travelling fellowships was inaugurated to enable senior research workers to keep abreast of research in agricultural science abroad.

Among other things funds were provided for research and advisory work on plant diseases and pests. Three institutes were founded to deal mainly with fundamental research on plant diseases and pests: one for plant pathology at the Royal Botanic Gardens, Kew; one for agricultural entomology at Manchester University; and one for

agricultural helminthology at Birmingham University. As time went on scientific workers in plant diseases and pests were also appointed to the staffs of specialized research stations, including those at Long Ashton, East Malling and Cheshunt. For the local investigation and advisory work specialists in economic entomology and economic mycology were attached to certain universities and agricultural colleges in England and Wales, and they became members of the staffs of those institutions.

The smooth and rapid working out of the scheme was inevitably impeded by the exactions of the Four Years' War and post-war reconstruction. Nevertheless, the scheme evolved prior to 1914 governed subsequent development continuously, and the organization of to-day is the outcome of a plan conceived some thirty years ago.

Before describing the present position it may be advantageous to refer briefly to two of the earlier developmental changes that occurred.

In May 1917, a sub-committee of the Technical Committee of the War-time Food Production Department was formed to advise the Department on questions relating to pests and diseases. This sub-committee consisted of the leading mycologists and entomologists in the country, with the Entomologist to the Board of Agriculture as convener. One of its activities was to inaugurate a plant disease survey by means of a system of monthly reports, prepared by specially qualified honorary correspondents in all parts of the country. These reports were collated, summarized and issued the following year as a Miscellaneous Publication of the Board of Agriculture, which, in point of fact, proved to be the first of a series of reports on diseases and pests of crop plants that have since been issued from time to time.

In 1918 the Plant Pathology Laboratory that had been founded at the Royal Botanic Gardens, Kew, four years before, was reorganized. The *research* side of it was combined with the fundamental entomological work previously carried on at Manchester* and the whole was transferred to Rothamsted, Harpenden, in order to provide the nucleus of a national Institute of Plant Pathology, which was intended to form an entirely separate unit of the Rothamsted Experimental Station, though ultimately responsible to the Director and Managing Committee of that Station. As a matter of fact the independent Institute envisaged never came properly into being, and although kept administratively distinct for a time, its functions were merged into those of the Station and its two components became merely departments of Rothamsted. The *administrative* and *advisory* side of the Kew Laboratory remained at Kew for a time, but became

* The research on agricultural helminthology carried out at Birmingham University was ultimately incorporated with the work of the Department of Helminthology in the London School of Tropical Medicine.

a constituent part of the Board of Agriculture, under the direction of J. C. F. Fryer, the Board's Entomologist. A new post of Mycologist to the Board was created at the same time and A. D. Cotton was appointed to it. The Laboratory was transferred to Milton Road, Harpenden, during the period October 1920–April 1921, and in October 1923 G. H. Pethybridge succeeded Cotton as the Board's, by then the Ministry's, Mycologist. One of the post-war functions of this Laboratory was to assume responsibility for the plant disease survey work begun in 1917, for the Food Production Department and its Technical Committee had been a purely temporary organization called into being by the exigencies of the war and dissolved after its conclusion.

Enough has perhaps been said to give an idea of the evolutionary history of the plant pathology service in England and Wales. The scheme was in more or less full working order by about 1923. Since that time little increase has occurred in the advisory personnel until the last year or so, but the research side has slowly and steadily expanded, both within and outside the framework of the original scheme.

At the present time there are two distinct sides to the phytopathological service, the official and the non-official.

The official side is staffed by civil servants, and consists of an administrative unit in the Horticulture Branch of the Ministry of Agriculture, some forty members of the Ministry's Inspectorate, and the Plant Pathological Laboratory at Harpenden. The first two groups are responsible for the administration of existing internal legislation in regard to diseases and pests, and for the extensive work necessary in the certification for health of imported and exported consignments of plants, an aspect of the subject that lies outside the scope of this address. It need merely be stated that these duties occupy only part of the time of the officers concerned. The primary functions of the Plant Pathological Laboratory are to undertake the scientific work required for the efficient administration of the Destructive Insects and Pests Acts, and to advise on the need for research and advisory work on diseases and pests, and the means by which it can be carried out; in short, to act as the co-ordinating centre for the whole service. It has a small staff of entomologists and mycologists, and among other things is responsible for the preparation of official leaflets and memoranda on diseases and pests, and is in charge of the intelligence system by which information regarding the distribution, spread and economic significance of diseases and pests is collected and distributed. The laboratory also shares to a limited extent in both research and advisory work. A significant innovation on the research side during the last few years is that research workers have been directly attached to the laboratory for the investigation of specific projects under the direction of the Ministry's Mycologist.

The non-official side of the service includes mycologists and entomologists attached to the Research Stations, and the corps of Advisory Mycologists and Entomologists on the staffs of the Universities and Agricultural Colleges. None of these workers is in any sense a civil servant. For their maintenance the Development Commissioners, through the Ministry of Agriculture, make an annual contribution to the funds of the institutions at which they are stationed. Some of the research stations have substantial sources of income apart from the Development Fund grant, while others are almost entirely dependent on the Fund. At the same time, all the contributions made are purely grants-in-aid and the State has no direct administrative responsibility. Grant-aided research workers in plant diseases and pests are stationed, for instance, at the Rothamsted Experimental Station, the two fruit stations at East Malling and Long Ashton, the Station for glasshouse problems at Cheshunt, and the Horticultural Research Station, Cambridge. Special provision was made for the study of virus diseases by the establishment at Cambridge in 1926 of the Potato Virus Research Station, now the Plant Virus Research Station. Two years later a special group of workers was organized, and stationed at Rothamsted, to investigate the fundamental nature and properties of plant viruses. This scheme was aided until 1933 from the funds of the Empire Marketing Board, but is now maintained by a special grant from the Development Fund. Other special, as distinct from normal, annual grants may also be made from the funds of the Development Commission and of the Agricultural Research Council to research stations and university departments for various specific purposes.

The specialist advisory service in plant pathology is provided for wholly from the Development Fund. Before the outbreak of war in 1939, it consisted, as a rule, of one mycologist and one entomologist in each of thirteen agricultural provinces, though in one province the advisers had permanent assistants, and in several others temporary assistants had been appointed for special purposes. As a war-time measure, the service has been expanded by the appointment of one or more assistant mycologists and entomologists in most provinces and, on the entomological side, by the organization of special teams of junior assistants for wireworm survey work. The advisers diagnose troubles for growers in their provinces and prescribe suitable treatment, act as intelligence officers of the Ministry for diseases and pests, and carry out investigations and experiments on what, theoretically, should be local problems. It should be realized that a considerable amount of advisory work on plant diseases and pests is also done by county staffs; that is, by the horticultural and agricultural officers of the County Agricultural Education Authority. To this extent, therefore, these county organizers and instructors are part of the non-

official phytopathological service. In point of fact, the salaries of these officers are largely state-provided.

Such, in brief, is the general system as it exists to-day in this country. A few other activities are state-aided through the Ministry of Agriculture, including the work of the Official Seed Testing Station at Cambridge, which, among other things, provides information to inquirers about the presence or absence of parasitic organisms on certain kinds of seeds. Important contributions are made by various other unrelated, but state-aided organizations. The Advisory Council of the Department of Scientific and Industrial Research, for instance, is responsible for the maintenance of various stations where plant pathological research is carried out. These include the Low Temperature Station at Cambridge and the Ditton Laboratory at East Malling where, among other things, problems of disease in relation to the storage of fruit and vegetables are investigated; the Pest Infestation Laboratory at Slough, for studying pests of stored products; and the Forest Products Research Laboratory at Princes Risborough, where the causes and conditions of decay in timber and the problems of wood preservation are studied. The pathology of forest trees, on the contrary, is in the hands of a distinct body, the Forestry Commission. Mention must also be made of the pathological work carried out on behalf of the Royal Horticultural Society at Wisley; the provision of funds by commercial and other bodies for research along special lines, as, for example, the investigation of sugar-beet diseases; and lastly, but by no means least, the ever-growing influence of the expanding research and selling organizations of commercial firms producing pest control products.

Behind all this organization and, of course, vital to its success, are the University Departments of Botany. In addition to normal undergraduate training, and the results of research carried out by the staff and graduates of the University, there are the post-graduate schools for training agricultural research scholars and overseas workers, and thus ensuring continuity in recruitment to the phytopathological service as a whole. On the mycological side these have been built up in particular by F. T. Brooks at Cambridge and by W. Brown at the Imperial College of Science.

The Imperial Mycological Institute, which is primarily concerned with the co-ordination of mycological and plant pathological work in the overseas parts of the Empire, is having an increasing influence in home phytopathological matters. If I say nothing of this, however, or of the continued help given by the mycologists at Kew and the British Museum, not to mention their opposite entomological numbers, it is not that I am unmindful of their importance in the scheme of things, but rather that I desire to distinguish clearly between the study of plant diseases and the study of fungi and insects as such.

It will readily be conceded by all who know the facts that the existing service has been of great and vital assistance during the past thirty years or so. It may therefore be more profitable to refrain from extolling its strength in order to spend more time in probing its weaknesses and considering possible ways in which its efficiency might still further be increased.

On the whole the needs on the horticultural side have been more adequately met than those on the agricultural side. Perhaps the most urgent need is to remove the serious 'bottle-neck' that exists between science and practice. A great volume of knowledge is available, and much of this should long ago have passed into general routine practice. It never will do so, however, until the grower has been convinced by demonstration, and until he appreciates the meaning of what he is expected to do and why it should be done. This involves personal contact, which can be made only to a very limited extent by a handful of specialist advisers. Mere numbers, of course, do not provide the answer. Nor do leaflets, bulletins, broadcasts and other forms of publicity. These can and must play their part, but they become really effective only after personal contact has been made and understanding reached. Nor can one look with equanimity on the prospect of advisory work passing largely into the hands of organizations whose interests must necessarily be influenced by the need and desire to sell their own products.

It would seem that the gap between the county organizer and instructor trained in agriculture or horticulture, and the specialist economic mycologist or entomologist, is too big. It is surely just as important to understand the principles and practice of hygiene and disease control as it is to understand the principles and practice of crop cultivation. Many growers fail to reap the full reward of their undoubted knowledge and skill in growing their crops because of the ravages of common diseases and pests. Yet it is not that these growers are incapable of understanding or profiting from plant pathological advice. In matters of cultivation they can often teach as well as learn from their scientific advisers, and with proper explanation and demonstration in the field they would soon be capable of understanding and discussing plant pathological matters. If the truth of this is granted—and there is surely no reason, for instance, why one who fully understands the art of pruning should not fully understand the significance of mummied fruits attacked by Brown Rot—then it must also be admitted that an organizer or instructor, trained in plant pathology and having a working knowledge of agriculture or horticulture, is just as much a necessity as one trained in agriculture or horticulture and having a working knowledge of plant pathology. The main function of such an organizer or instructor in plant pathology should be to see that the results of research are put

into practice, and the measure of his success in doing this will depend on the extent to which he is able to pass on the knowledge he himself possesses. Clearly, he does not need the higher training of the advisory mycologist or entomologist, but he should be familiar with the symptoms and control of all the troubles that lead to economic crop losses, whether they are due to bacteria, fungi, insects, viruses or other causes. All this implies a more general and less specialized knowledge, the possession of which will lead to an easier approach to the grower, facilitate the ever more insistent need for closest co-operation between the varied interests that are concerned with plant pathology, and obviate the practical difficulties that confront the specialist officer who may not, or dare not, deal with matters outside his own particular subject, however competent he may be to do so.

Another source of weakness in the present system is the loose connexion between different components of the service. Of the two distinct types of advisers, one—the local organizer or instructor in general agriculture and horticulture—is responsible to the County Agricultural Education Authority and the other—the specialist economic mycologist and entomologist—to the University or Agricultural College where the provincial advisory centre is stationed. Collaboration between the two is inevitably almost wholly dependent on personal relations. In the same way the link between the specialist advisory officers and the Plant Pathological Laboratory is a slender one. Advisory officers are appointed by a university or college and are subject to the authority of those bodies. Their only statutory obligations to the Ministry of Agriculture and the central laboratory are to attend one or two conferences a year, and to prepare monthly and annual reports on the prevalence of diseases and pests in their provinces and on the work carried out during the year. Although these statutory obligations are important and are, indeed, satisfactorily fulfilled, something more than this is required, and, happily, informal collaboration is, in most instances, a great deal closer than is implied by this statement. On the other hand, there is little or no direct collaboration between the county organizers and instructors and the central laboratory.

As regards research, it would seem that just as it is illogical to try to divorce 'fundamental' from 'applied' research, so it is almost impossible to distinguish between local and national disease and pest problems. The local investigations carried out by the advisers have been determined largely by the kind of crops grown in their provinces; and for the most part advisers have become specialists on the diseases or pests of a limited range of crops. With the general tendency towards division of work on a crop basis there is justification for merging this aspect of advisers' activities with the work of the research

stations, provided that that work is reorientated to give as much emphasis to field as to laboratory and plot experiments.

It is difficult to avoid the impression that the general research programme has expanded in some respects in a rather haphazard fashion. This is perhaps inevitable when the general policy adopted is one of decentralization and of grants-in-aid without direct administrative responsibility. Nevertheless, grants can no longer be decided as in the past on a general principle, such as that of helping already existing institutions on a £ for £ basis. With the passage of years income received from the State has in most instances steadily overtopped that from other sources, and assistance must now depend on the sum required for the effective execution of an approved programme of work, even if this involves the whole income of an institute being derived from the State. Thus, there now seems to be no insuperable objection to the establishment of one or more national institutes fully maintained by the State, though not staffed by civil servants.

With the above considerations in mind and without unduly or unnecessarily disturbing the existing framework of organization, I am tempted to visualize the existence of a closely knit Phytopathological Service, each component of which would cover the whole field of plant pathology in the widest sense of that term. The Service would thus include economic mycologists and entomologists, virus workers, helminthologists, bacteriologists and agricultural biochemists, as well as those concerned more particularly with non-parasitic troubles. It would consist of an official side with its Plant Pathology Laboratory and inspectorate, and a non-official side comprising one or more essential national institutes, a chain of research stations, substations and observation posts organized on a crop basis, and a large corps of advisory plant pathologists or plant doctors, attached to the County Agricultural Education Authority.

The central Plant Pathology Laboratory would be a State building, fully equipped and staffed for co-ordinating every aspect of the work. In essentials its activities would differ little from those at present undertaken and outlined above, but an appreciably enlarged staff would provide much-needed scope for planning research, improving publicity, organizing co-operative trials and pest control campaigns, increasing the value of the intelligence system for obtaining information about the prevalence and intensity of disease, and above all for maintaining the closest possible contact with both field and laboratory work throughout the country. For these purposes the assistance of a biochemist, statistician, virus worker, bacteriologist and helminthologist would be needed in addition to mycologists and entomologists.

This central laboratory would be situated within easy reach, and preferably within the extensive grounds, of one or more National

Institutes for which there is undoubtedly a need. Great strides have been made in virus work in the last fifteen years, but little or no attention has been given to bacterial plant diseases, except in the botanical departments of the Imperial College of Science and Cambridge University, and at the East Malling Research Station. The present demand from plant pathologists in all parts of the country for assistance in diagnosing both bacterial and virus diseases cannot be satisfied without making serious inroads into the normal work of the few who are in a position to help, and whose time for research should not be taken up by routine diagnostic work. A similar state of affairs is now arising with regard to deficiency diseases. I would therefore suggest the establishment of one or more institutes where research on the more fundamental aspects of these subjects can be centralized, and where diagnostic work can freely be undertaken. These institutes would be quite distinct from the ordinary research stations. On the one hand, they would be more directly concerned with the causal agents of disease than with the diseases themselves. On the other hand, they would provide a source from which plant pathologists in general could readily obtain identification of bacteria and viruses, much in the same way as Kew and the British Museum have for many years provided invaluable help to economic mycologists in the identification of fungi. Indeed, there is much to be said for gathering together the work on fungi under a single roof. A national station for testing proprietary pest control products would also be situated appropriately among this cluster of buildings.

The Research Stations would be organized on a crop basis, and each would have its Department of Plant Pathology. There might, for instance, be different stations for cereal and root crops, potatoes, vegetables, fruit, and ornamentals. Each station would be situated in or near the most important area where the particular crops to be investigated are grown. In order to carry out the local investigations previously assigned to the specialist advisory officers, and to study the effect of local climatic and soil factors, each main station would have substations in different areas. If the main fruit station for the eastern half of the country were situated, for instance, in Kent, a substation would certainly be needed in the Wisbech area. In some instances the substations might be substantial buildings more or less fully staffed; in others they might be much smaller, but substantially built, field laboratories, or merely observation posts involving the use of a room at a farm institute or college as headquarters during a few weeks' field observations. The exact composition of the plant pathology staff would vary from station to station, but economic mycologists and entomologists would probably be essential to all. Advantage would also be taken of individual propensities. At the main station the staff would tend to include those with leanings towards laboratory

work and plot experiments. Those more disposed to field work would be in charge of the substations and would also act as liaison officers between the research stations and the corps of advisory plant pathologists or plant doctors, assisting for instance in co-operative trials, in demonstrations, and in diagnostic work on the less common diseases and pests. At the same time they would act as intelligence officers on behalf of the Plant Pathology Laboratory.

In addition, each research station would have its publicity or public relations department, which would be responsible, among other things, for translating the results of the research into practical recommendations, for co-operating with the central Plant Pathology Laboratory in the preparation of leaflets, bulletins and other forms of publicity, and for organizing regular refresher courses for the corps of plant pathologists.

The qualification necessary for the plant pathologists or plant doctors would be a diploma, equivalent perhaps to the National Diplomas in Agriculture and Horticulture. In awarding such a diploma it would be essential that practical ability should count as much as theoretical knowledge. County boundaries do not form a natural agricultural or horticultural division, but administratively these plant pathologists would perhaps most conveniently be attached to the County Agricultural Institutes, the personnel of which is already largely maintained by the State. The number of appointments would vary from county to county. The duties of these pathologists would be to get the news across to the grower by demonstrations, by meetings and lectures, and above all by personal explanation in the field or on the allotment. They would, in short, be county instructors, not in agriculture or horticulture, but in plant pathology, using the term in its widest sense; and they would be specially trained for that purpose. The higher posts in the county organization would naturally be open to them. In addition, these plant pathologists would be closely linked, on the one hand with the public relations departments and the individual officers of the research stations, and on the other with the central Plant Pathology Laboratory. They would, indeed, become the main source of intelligence information regarding the prevalence and intensity of diseases and pests.

One other point: closer co-operation between the general service and the more specialized auxilliary services is both desirable and possible. It is quite wrong, for instance, to assume, as is sometimes done, that the industrial problems of potato storage begin only when the tubers are clamped, or that the claims of fruit diseases pass in some mysterious way from the realm of the horticultural pathologist to that of industrial research as soon as the fruit is picked.

Recruitment to the service as a whole would follow much the same course as at present, except that better provision is needed at most

Universities for adequate training in the study of virus and bacterial diseases. In addition, new and special courses would be required at the County Agricultural Institutes and at Agricultural Colleges in order to ensure a continuous flow of suitably trained plant doctors. It is perhaps scarcely necessary to add that the success of any such phytopathological or other agricultural service must depend, in the long run, on improved education from an early age of those who are to take up farming or gardening pursuits, and more attractive prospects in these industries after the war.

For any phytopathological service to be effective and successful, active official co-operation between the different components of it is essential, but the personal and unofficial relations between the individual members of the service also play a big, if not a decisive part. I would therefore like to turn for a while to an entirely different aspect of my subject. There are a number of associations that exist for the welfare of agricultural research workers in this country. Among them are the Agricultural Education Association, the Horticultural Education Association, and the Association of Scientific Workers, all of which include plant pathologists among their members, but the only bodies that attract the majority of plant pathologists are the Association of Applied Biologists and our own Society.

From its earliest days the British Mycological Society has given every encouragement to the plant pathologist. It was not surprising therefore that when, at the Annual General Meeting at Baslow in September 1919, the need for the Society to take a more active part in the development of plant pathology in Great Britain was urged, the first reaction of members was to emphasize, not for the first time, that the Society already included in its scope *all* branches of mycology. In spite of this, three months later a special subcommittee was appointed by the Council to deal with questions of interest to plant pathologists. It consisted of six members, including the President and Secretary, with F. T. Brooks as Chairman and A. D. Cotton as Secretary. The personnel of the subcommittee was enlarged from time to time by co-option, and ultimately consisted of twelve members, who remained continuously in office until 1930. At the Annual General Meeting at Whitby in September of that year the subcommittee was reconstituted and its future discussed, and at Belfast the following year it was decided to add to the rules of the Society one defining the status and aims of the Plant Pathology Committee, as it was then to be called. The Committee was given an exceptionally large measure of autonomy, and its new constitution ensured the advantages to be gained from regular but not too violent changes of personnel.

Since its formation, and especially in recent years, the Committee has materially assisted the development of plant pathology and, it

might be added, of mycology in this country. For the past eighteen years it has organized an annual phytopathological excursion, and since 1933 has arranged one of the annual winter meetings of the Society, at which the programme has been devoted to discussions or papers of phytopathological interest. In 1929 the Committee completed the compilation and publication of a *List of Common Names of British Plant Diseases*, and this undoubtedly acted as a stimulus to the preparation of similar lists in different parts of the Empire and elsewhere. A second edition appeared in 1935 and a third is in preparation. Curiously enough, although the primary object of the work was the standardization of the common names of diseases, the increasing value and importance of the *List* lies in the standardization of the scientific names of the pathogens. Not only have over forty Societies, Institutes and Offices in this country agreed to use the recommended names of fungi in their official publications, but the scientific names in the *List* have evidently often been copied without hesitation in foreign literature, and they have also been chosen to serve as a foundation for a list of Scandinavian diseases now being compiled. There is therefore some point in suggesting that the Society, as distinct from the Committee, might assume a more direct interest in the future of the *List*. This applies even more to another very important activity initiated by the Committee in 1935, when it was decided to organize the compilation of lists of individual groups of fungi, such lists to be arranged on a common pattern and to include all records of British fungi referred to in British or foreign works. Lists of British Pyrenomycetes, Ustilaginales, and Hyphomycetes have been published during the last fourteen months, and every encouragement should be given to ensure that the task is completed. The work involved is necessarily long and arduous, and its importance is perhaps not yet fully realized, but I look forward to the time when all the lists have been prepared, brought up-to-date, co-ordinated—as they readily can be—and published in one or more volumes containing all the records of all British fungi.

Two other activities of the Plant Pathology Committee deserve mention. Last year the question of proprietary prophylactic products was thoroughly discussed. The subject proved far too wide to be dealt with solely by the economic mycologist, and it was referred to a Joint Committee appointed by the Plant Pathology Committee and the Association of Applied Biologists. Within a surprisingly short time the Joint Committee prepared a comprehensive report in which definite proposals for the official testing and recognition of proprietary pest control products were put forward, and this report has been submitted to the Ministry of Agriculture and has been accepted by them as a basis for further discussion. Encouraging progress has also been made during the last few months in a new effort intended ultimately

to provide accurate information about the prevalence and intensity of plant diseases in this country.

From this brief account of the activities of the Committee it is clear that those interested in applied mycology have taken full advantage of the facilities so generously afforded by the Society and have benefited accordingly. In view of this, it may at first sight seem paradoxical, if not ungrateful, for a plant pathologist—and especially one who has been closely associated with the Committee—to suggest that a continuance or even further extension of those facilities may in future not be the best course either for the plant pathologist or the mycologist. Two things seem clear: one that the Plant Pathology Committee has sometimes strayed into ways more fitly those of the Society as a whole, and the other, that at times its work has been hampered and restricted by the rather narrow paths it must necessarily follow. Applied mycology can at most form only a part of plant pathology. Even if plant bacteriology is legitimately regarded as coming within its meaning, we are faced with the fact that little help and encouragement have been given by anyone to the very few who have studied bacterial diseases in this country. The Society can naturally not expect any close allegiance from those primarily interested in viruses and virus diseases, and however far the meaning of the term mycology is stretched it cannot embrace the vast and much neglected field of nutritional and other non-parasitic disorders.

When the Association of Applied Biologists was founded, one of its primary objects was 'to provide and advance the science of Economic Biology in its agricultural, horticultural, medical, and commercial aspects', and it soon became the recognized society for all British workers interested in applied biology. To a large extent the meetings of the Association may be said still to conform to the original purpose, but it seems to me that this is not now reflected either in the membership or in the *Annals of Applied Biology*. The great majority of the members are concerned in one way or another with the pathology of plants, and it is this subject that has furnished by far the greater part of the material published in the *Annals* during the past ten or twelve years.

There is inevitably much overlapping between the existing functions of the two bodies to which most of our plant pathologists belong. This duality of purpose, the limited field of plant pathology covered by the Plant Pathology Committee, the undeniable trend within the Association of Applied Biologists and various other reasons into which I need not go now, have led me to what is a purely personal conviction, namely, that in the long run the future of plant pathology and mycology in this country would best be served if these two bodies merged into one. Sacrifices would be necessary, as they usually are when reforms are made, but I believe the gains would more than

offset them. On the one hand, the Plant Pathology Committee would cease to exist as a more or less autonomous part of the British Mycological Society. On the other hand, it would be necessary for the Association of Applied Biologists to recognize and admit its changing development by deliberately setting out to become an association of all those interested in the pathology of plants. I feel sure that from a union such as is suggested there could indeed come a powerful Society or Association of Plant Pathologists in the widest and correct sense of that term. With an influential *Journal* or *Annals of Plant Pathology*, and a close liaison on the one hand with the British Mycological Society, and on the other with the Royal Entomological Society, it could play a leading part in developing and co-ordinating the various subjects that constitute the wider conception of plant pathology.

It is not, I think, irrelevant to add a few comments on a possible future for our own Society, in the light of the suggestion made. Any considerable reduction in the phytopathological activities of the Society would make a gap, it is true, but one that I feel sure could soon be filled. Moreover, although about 40 % of present members resident in Britain are professional plant pathologists, I believe few of them would relinquish their membership. The mycological activities of the Society, for which the Council is nominally responsible, have in practice been left largely in the hands of the Officers. To encourage further activities, and at the same time to obtain a more equitable division of labour, it would be highly advantageous if the Council were to meet regularly. Appropriate committees appointed by Council would be in a position to take over responsibility for the *List of Common Names of British Plant Diseases*, or *List of Common British Plant Diseases* as it is to be called in the next edition, and also for the lists of British fungi. Further, it is much to be hoped that the pioneer work in preparing arguments for and against the acceptance of the many names proposed as *nomina generica conservanda*, begun by the Society's Nomenclature Committee in 1939, will be resumed at the first opportunity, and will be pressed to its logical conclusion at the next International Botanical Congress.

Activity need by no means stop there. Other possibilities will doubtless occur to all of you, but there is one relating to the training of plant pathologists that I should like to emphasize. Most postgraduate plant pathologists have a working knowledge of the classification of the pathogens they deal with, but very few, if any, understand the principles underlying the nomenclature of fungi. Too often the economic mycologist is left to discover for himself the significance of exsiccata and type material, the intricacies of the rules of botanical nomenclature, and the correct way of describing the fungi he investigates. The Society could and would confer a great service to plant pathology if it took the lead in an attempt to rectify this state of

affairs, for it must be admitted that such matters can be taught only by those who have already learnt.

When all is said and done, however, the fact remains that the reputation of the Society was built up on field work, and in the long run its future prosperity must depend largely on a return to the collecting tin. I would like to see a few young and enthusiastic collectors given the opportunities so freely granted by the Society to plant pathologists during the past decade or so. Set them to work for a time among the local Natural History Societies with a view to obtaining at least one recruit from each district; and then see that those recruits have all the encouragement they will need. They will at first no doubt regard themselves as very small frogs in a big pond, but their influence as big frogs in their own small local ponds would have an inestimable effect not only on the study of local fungus floras, but also on the vigour and further development of this Society.

In 1946 we celebrate our Jubilee. It was at Selby where the Society was founded in September 1896, Selby where it was reconstituted and strengthened in September 1918. I should like it to be said one distant day that it was Selby where, in September 1946, the Jubilee foray established yet another landmark in the history of the Society, because it signified the return to dominance of the collector and naturalist, whether professional or amateur.

BACTERIAL DISEASES OF STONE-FRUIT TREES IN BRITAIN

VIII. BACTERIAL CANKER OF PEACH

By H. WORMALD

(With Plate X)

During the course of the investigations on bacterial diseases of plum and cherry trees in Britain, attention has been directed to the possible appearance of similar diseases on other species of stone-fruit trees, and their occurrence on the almond (*Prunus Amygdalus*) and on the purple-leaved plum (*Prunus Pissardi*) has already been described (Wormald, 1938*a*). Bacterial Canker of peach was observed as long ago as 1927, but only on one tree, and it has not been noted again on peach trees in this country. In plum, cherry and almond, Bacterial Canker is associated with a leaf spot which has been shown to be the summer phase in the annual cycle of the diseases caused by the organisms *Pseudomonas prunicola* and *P. mors-prunorum*, and it is possible that a similar bacterial leaf spot occurs on peach trees in Britain, but if so it has not yet been recorded. Peach leaves in this country often show spots bearing a superficial resemblance to the bacterial spots of other host plants, but no bacteria have been found in these leaf spots of peach, the only organism commonly associated with them being a fungus, a species of *Hormodendron*. In America a peach leaf-spot disease of frequent occurrence is caused by *Bacterium Pruni*, but this organism has not been recorded in Britain. The cankered peach tree may have been infected with bacteria from leaf spots on that tree in 1926, but it is possible that infection came from bacterial spots on the leaves of neighbouring plum or cherry trees, for, as shown below, the organism on any one of these hosts can infect the other two. This account of Bacterial Canker in peach has been delayed in the expectation of finding the leaf-spot phase on peach, or of meeting with other examples of bacterial canker on this host, but no such disease has again come to my notice, and bacterial infection of the peach in Britain would seem to be rare. The observations recorded below show however that it is susceptible to bacterial canker, and the fact that it is a possible host of the canker organism is of some importance in considering control measures against this destructive disease of stone-fruit trees.

In May 1927, a young peach tree showing 'Die Back' was taken from a private garden at East Malling and examined. The variety was Hale's Early, grafted on Black Damas C. One side of the tree was almost dead (see Pl. X, fig. 1), and the cortex was brown along the whole length of this main branch. The discoloured cortex was found to contain numerous bacteria, so culture plates were prepared and an organism isolated, which, from the structure of its colonies and its habit in certain culture media, appeared to be identical with an organism frequently isolated from diseased plum and cherry trees about that time, and later named *Pseudomonas mors-prunorum* (Wormald, 1932).

In November 1927, inoculation experiments were carried out with the organism isolated from this peach tree.

Exp. 1. Inoculations were made on five young branches of a peach tree (var. Hale's Early) growing in a pot, five other branches serving as controls. The inoculations were made through small wounds, a drop of a suspension in water of the growth from a two-day-old agar culture being placed in each wound. The control branches were similarly cut but not inoculated.

When the tree was examined the following summer the control wounds had healed normally but at the inoculated wounds there were lesions 2–3 cm. long, four of them half girdling the branches while the other had completely girdled the branch and so caused the death of that part above the lesion.

Exp. 2. Inoculations were made on the main branches of young peach trees in nursery rows (var. Hale's Early on Arnold's Bush). Each tree was inoculated through Λ-shaped cuts at two places, one at about 1 ft. above the ground, the other higher up. The control trees were similarly wounded, but sterile water only applied to the cuts.

By the following summer lesions from 3 to 14 cm. long (mostly 6–10 cm.) had appeared at all the inoculated wounds and nine of the ten branches were girdled and dead above the lesions. Two of these are shown in Pl. X, figs. 2 and 3. No lesions developed on the control trees.

Exp. 3. This experiment was carried out to ascertain whether the organisms isolated from plum, cherry, and peach were able to infect all three hosts. Inoculations were made on comparable one-year-old branches on plum, cherry, and peach trees, and the results, as observed the following summer are shown in Table 1.

Table 1. *Results of inoculations with three strains of* Pseudomonas mors-prunorum

Strain isolated from	Length of lesions in cm. on		
	Plum	Cherry	Peach
Plum	4–10·5	0–2	3–6
Cherry	1–4	5–6	3–5
Peach	1–1·5	1–1·5	2–4

It will be seen that in each series the cankers produced by any one strain are longest on the same species of host plant as that from which the isolation was obtained. These results seem to indicate some degree of specialization, but, as the inoculations were comparatively few (four on each host with each strain) and with only one strain from each host plant, the evidence cannot be assumed to be conclusive, particularly since in more recent experiments it was found that among strains from cherry some were more virulent than others (Wormald, 1938*b*). The results suggest also that this particular peach strain was less virulent than those from plum and cherry, for the cankers it produced were, on the whole, on whichever host, smaller than those resulting from inoculations with the other two strains.

The organism from the peach canker has been compared in culture media with various strains isolated from plum and cherry trees. As only one isolation of the peach organism has been possible its range of variation has not been determined, but in most of its reactions it has been found to conform to those of strains of *Pseudomonas mors-prunorum* isolated from plum and cherry. The chief characters common to the peach organism and other strains of *P. mors-prunorum*, distinguishing them from the related organism *P. prunicola* which has also been isolated from plum and cherry trees, are:

Nutrient broth + 5 % *saccharose.* White cloudy growth, no yellowish tint.

Nutrient agar + 5 % *saccharose.* Rapid production of acid; the growth is usually dead in from 4 to 6 days, probably as a result of this high degree of acidity.

Nutrient agar + 2 % *lactose, with bromo-cresol purple as indicator.* Reaction at first alkaline, later acid, so that the medium turns yellow.

Uschinsky's solution. White cloudy growth, no yellow tint.

The various strains of *Pseudomonas mors-prunorum* that have come under study vary among themselves in their reaction when grown in milk cultures. Typically they produce a solid curd which has an acid reaction (yellow in milk containing bromo-cresol purple), but with a little whey above the curd.

The peach strain in milk cultures gave the following reactions as noted at the end of six months:

Plain milk. Indistinguishable from control tubes in colour and consistency, except for a trace of precipitate.

Litmus milk. Trace of precipitate; colour rather deeper than in control tubes.

Milk with bromo-cresol purple as indicator. A very slight change in the acid direction, but not enough to produce curdling.

Methylene blue milk. Eventually greenish (Dark Bluish Glaucous of Ridgway).

The plain milk cultures showed so little change from the control (not inoculated) tubes that it might have seemed doubtful whether

Fig. 3

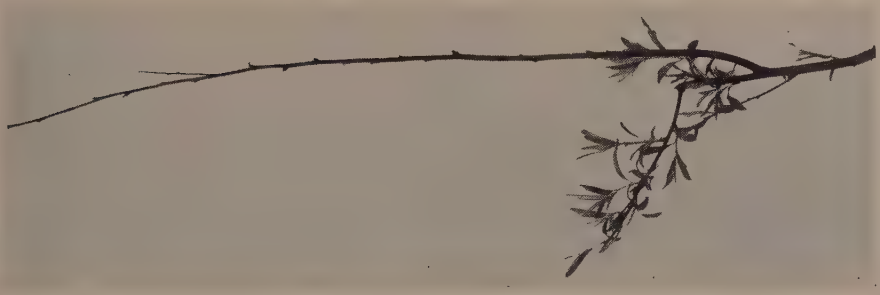

Fig. 2

Fig. 1

there was any noticeable growth at all in this medium, but the change of tint in milk containing any one of three indicators showed that definite growth must have occurred.

Since strains of *Pseudomonas mors-prunorum* from both plum and cherry show a range of reaction in milk cultures the characters shown in which the peach strain deviates from the type are not considered to have any specific significance.

Summary

A bacterial canker of a peach tree is described. The organism isolated from the canker, when inoculated into peach, plum and cherry branches, produced typical bacterial cankers. The organism in its chief characters conforms to *Pseudomonas mors-prunorum* Worm. and is therefore referred to that species.

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EXPLANATION OF PLATE X

Fig. 1. Peach tree with a bacterial lesion (natural infection) on the branch on the right; on this branch the leaves are withering.

Figs. 2, 3. Two peach trees each of which had been inoculated on the branch on the right in November, and photographed the following May.

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NOTES ON ENTOMOGENOUS FUNGI

By T. PETCH

161. *Empusa acaricida* Petch

The red-legged earth mite (*Halotydeus destructor*), a serious pest of certain forage crops in Western Australia, was found by Mr K. R. Norris to be attacked by a fungus which he identified as an *Empusa*, and subsequently Mr Norris sent me specimens from which it was possible to confirm his identification. No *Empusa* has been recorded on mites before, and this is a new species. Mites attacked by this fungus may be picked out in the field because of their change of colour. Normally the mite has a black body and red legs, but when attacked by the *Empusa*, the whole of the dorsal surface and the sides of the body become yellowish brown, and this area is sharply demarcated from the black ventral surface. An account of the fungus, including a formal description under the name *Empusa acaricida*, has been published in Australia in *Proc. Linn. Soc. N.S.W.* LXV, 259–60, 16 September 1940.

The mites killed by this *Empusa* are attached to the host plant by their mouthparts or are entangled in the tomentum of the leaf. There are no rhizoids. The conidiophores are short, stout and unbranched. The primary conidia are oval, $9–12 \times 5–7\mu$, or subglobose, $8 \times 6\mu$, always with a broad, truncato-convex papilla. The secondary conidia are similar, and are borne on a stout germ tube from any part of the primary conidium, but usually laterally, as in *Entomophthora Aphidis*.

162. *Cordyceps militaris* (L.) Link

Cordyceps militaris is a well-known parasite of lepidopterous larvae and pupae, to which hosts it is supposed to be confined, though there are records of its occurrence on Coleoptera, one by Roumeguère in *Revue Mycologique*, VI, 150 (1884), on a cockchafer, Dept. Aude, France, and another by Briard, in *Florule Cryptogamique de l'Aube*, p. 339 (1888), on the remains of a cockchafer buried in the soil in the wood of Bailly, Dept. Aube, France, while in Farlow and Seymour, *Provisional Host Index of the Fungi of the United States*, the entomogenous fungi of which were revised by Thaxter, *Lachnosterna quercina* is given as a host.

It has been surmised that either these records were erroneous, or that they really referred to *Isaria farinosa*, which was then believed to

be the conidial stage of *Cordyceps militaris*. It was a common practice at that time to record the perfect stage of a fungus, when only the imperfect stage had been collected, e.g. *Tuberculariа vulgaris* would be recorded as *Nectria cinnabarina*. In 1939, however, I was able to examine a specimen which, up to a point, supports the records quoted.

The specimen was collected on 16 September 1938 at Gönnebeck, East Holstein, by Dr Meyer who was engaged on an investigation of the cockchafer pest, and was forwarded to me by Dr H. Blunck, Director of the Institute for Plant Diseases, Bonn. It was said to have occurred on a second year cockchafer larva, buried at a depth of about half a centimetre. I have not seen the larva, but in the circumstances there should be no doubt about the identification. The larva was covered, except for the head, with an irregular, dirty white mycelial layer, with rhizomorphic strands spreading through the soil. From the neck arose a group of four clavae, 15–20 mm. high and about 2 mm. diameter, sealing-wax red in colour when fresh. The lower part, or stalk, of the clava was almost smooth, while the upper third, or head, was rough with projecting ostiola. The clavae resembled exactly in appearance and structure rather stout clavae of *Cordyceps militaris*. Unfortunately they were quite immature, and I was unable to find asci. It is possible that the fungus may have ascospores different from those of *C. militaris*; and at present it cannot be decided whether *C. militaris* can attack Coleoptera, or whether there is another *Cordyceps*, indistinguishable from *C. militaris* on macroscopic characters, on those hosts.

163. *Cordyceps typhulaeformis* Berk. & Cooke

This species was discussed in *Trans. Brit. Mycol. Soc.* XVIII, 49 (1933), where it was stated that although Cooke described the colour as red, there was no trace of red on the type specimen now, the colour being brownish yellow or dark amber and subtranslucent, and brownish yellow internally. I have since been able to examine further specimens of this species, and it appears to be certainly red when fresh.

Specimens on cocoons of nettle grub (Lepidoptera) from the Tea Experimental Station, Nilgiris, South India, were submitted to me in September 1934 by the Imperial Mycological Institute. The collector's note described it as orange-red, club-shaped. Numerous clavae arose from a single cocoon. The clavae were straight or curved, 1–2 cm. high, with a cylindrical or clavate, terete or more usually laterally flattened head, 4–10 mm. high, 1·5–2 mm. diameter, and a stalk 1·5–2 mm. diameter or broad. The stalk sometimes branched above, but only in one instance was a lateral branch fertile. The perithecia were usually lacking on a longitudinal band down one

side, but on the smaller specimens they were continuous; they appeared free, but evidently they were at first embedded in loose tissue up to two-thirds their height. The immature perithecia were flask-shaped, with a subcylindrical obtuse apex, up to 0·6 mm. high, 0·25 mm. diameter. The specimens had been preserved in formalin, and asci and spores could not be found.

Another specimen was included in a collection of entomogenous fungi from the Herbarium of the Missouri Botanic Garden, 'Clemens 7793 F, New Guinea, Morobe, Sambanga. Orange red fungus on caterpillar, November 26, 1937'. Fourteen clavae, up to 1 cm. high, grew from a hairy caterpillar. They were red and subtranslucent, with an ovoid or subglobose head, and strongly projecting free perithecia with yellow mycelium between them, sometimes lacking down one side of the head. The perithecia were conoid, obtuse, 0·6 mm. high, 0·5 mm. diameter. This specimen was mature, the asci being capitate, 4μ diameter, and the part-spores rod-shaped, 4 × 1μ.

I have also seen a specimen on a pupa from Behungi, Uganda, 4 April 1927, Linder no. 2526 in the Farlow Herbarium, in which the pupa bore two clavae only.

As the result of these examinations, the synonymy given in the previous note must be revised. *Cordyceps mitrata* Pat., *C. flavobrunnescens* P. Henn., and *C. coccinea* var. *subochracea* Penz. & Sacc., all from Java, are I think the same as *C. typhulaeformis*, but *C. deflectens* Penz. & Sacc. is most probably different.

164. *Isaria Cicadae* Miq. and *Cordyceps sobolifera* (Hill) Sacc.

In *Trans. Brit. Myc. Soc.* x, 39 (1924), *Isaria Sinclairii* (Berk.) Lloyd was redescribed from Ceylon specimens, with a photograph, and it was stated that it did not appear to differ from *I. arbuscula* Hariot from Mexico. That was followed in the same journal, xvi, 66 (1931), by a note on *I. Cicadae* Miq., the type of which came from Brazil, and later, in xviii, 64 (1933), after examination of specimens from Mexico in Herb. British Museum, the latter name was adopted for *I. Sinclairii* and a number of other species which had been recorded on cicadas. Most of the synonyms there given are cited for *I. Sinclairii* by Kobayasi in 'The genus *Cordyceps* and its allies' (*Science Reports Tokyo Bunrika Daigaku*, B. No. 84, v, 53–260, 1941), though he apparently dissents from its reference to *Isaria Cicadae* Miq. The same writer remarks (p. 245): 'Some authors think that this (*I. Sinclairii*) is the conidial stage of *Cordyceps sobolifera*, but against such a speculation we may mention the fact that the latter fungus is provided with the pycnidial lateral branches with conidia as already mentioned.'

In 1938, through the kindness of Professor C. W. Dodge, I was able

to examine a large number of specimens of *Cordyceps sobolifera* and *Isaria Cicadae* from the herbarium of the Missouri Botanic Garden, collected at San Sebastiad, Jalisco, Mexico (date not stated). Some isarial specimens had a large subglobose head, up to 1·5 cm. diameter, on a comparatively thin stalk, the individual branches of the head being more visible than is usual in fresh specimens of *I. Sinclairii*, though that may have been due to loss of conidia after collection. Others had clusters of branches arising directly from the insect, without a main stem. Clusters of conidial branches also arose from the stem of the perithecial clavae, or even from the head in immature specimens; and conclusive evidence of the relationship of *Cordyceps sobolifera* and *Isaria Cicadae* was provided by specimens in which the main stem divided into two or three stems, of which one terminated in the *Isaria* and the others in the *Cordyceps*.

In these specimens, the processes on the perithecial clavae were branches, often short and scattered, terminating in a conidial head, though in one instance the processes, arising just below the head, were long and branched, forming an isarial cluster which extended to half the height of the immature head. In a previous account I stated that these branches (soboles) were apparently easily detached; that was not so in the present specimens, in which the processes were stout branches, not separable without fracture. Some perithecial clavae showed no trace of soboles; others bore minute white points which might indicate where branches had been broken off, or more probably where they were beginning to develop.

The conidia in these specimens were cylindric with rounded ends, or very narrow oval, $7–11 \times 2·5–3\mu$. The total height of the perithecial clavae was up to 8·5 cm., with a cylindrical head, rounded at the apex when mature, 2 cm. high, 3 mm. diameter, rough with slightly projecting ostiola when dry. The asci were $5–7\mu$ diameter, according to the degree of maturity of the spores, and the part-spores cylindrical, ends truncate, $7–12 \times 1–1·5\mu$.

It is to be noted that Berkeley described the head of *C. sobolifera* as globose. In a West Indian specimen in Herb. British Museum, illustrated in *Trans. Brit. Myc. Soc.* XIX, 175, Fig. 2, the head is elongated oval. In a photograph of a specimen from the Bahamas, reproduced by Lloyd, *Mycol. Notes*, V, 584, the head is clavate. The latter specimen shows conidial processes on the stem, bearing, according to Lloyd, narrowly elliptical conidia, about $8 \times 4\mu$. It is evident that the shape of the head of *C. sobolifera* is variable, as indeed it frequently is in *Cordyceps*, e.g. *C. militaris*.

The specimens described above leave no room for doubt that *Isaria Cicadae* is the conidial stage of *Cordyceps sobolifera*. The latter species, however, has recently been redescribed by Kobayasi from Japanese specimens. His description agrees in the main with the Mexican

specimens as regards the perithecial stage, but he states, with figures, that the processes or soboles are pycnidial. Nothing resembling these pycnidia has been observed on the Mexican specimens. It may be that *C. sobolifera* produces both pycnidia and conidial synnemata on the perithecial clavae, but that is a matter for further enquiry. No *Isaria* stage has been reported for *Cordyceps sobolifera* from Japan, though *Isaria Cicadae* (*I. Sinclairii*) occurs in that country.

165. *Cordyceps* on mole crickets

In *Mycol. Notes*, VI, Fig. 1622, C. G. Lloyd published a photograph of an immature *Cordyceps* on a mole cricket under the name, *C. Gryllotalpae*; and on p. 913 he wrote: 'There are several specimens of this [at the New York Botanical Garden] on "ground puppies" or "sand moles", as Curtis calls them. They were sent to the Garden by E. C. Wurzlow, Houma, La. All are immature, but I have no doubt are young *Cordyceps*. Curtis lists the name but nothing further, and I did not find at Kew that he had sent any specimen to Berkeley.' The name does not appear to have been known to Cooke or Massee.

Lloyd's reference to Curtis is somewhat tantalizing, as he did not indicate where the list referred to was to be found or whether there was any specimen in the Curtis herbarium. As the name does not appear in any previous account of the genus *Cordyceps*, it would seem that it was a manuscript list. Moreover, there is no indication whether Curtis's specimen was a North American one or a Wright specimen from Cuba. The specimens at the New York Botanic Garden, of course, have no connexion with Curtis, and the assignment of his name to them rests on a series of assumptions which would only be justifiable if only one species of *Cordyceps* occurred on mole crickets. The photograph shows several (? nine) narrow clavae directed backwards more or less parallel to the insect, and suggests that the latter was upside down in its burrow, or that the clavae had been bent over in packing. Until more specimens have been collected in Louisiana, it is uncertain whether the mature clavae are linear or develop a head.

In his 'Genus *Cordyceps* and its allies' (1941) Kobayasi gives the name, *Cordyceps Gryllotalpae* Ellis & Seaver, for a Japanese *Cordyceps* on *Gryllotalpa*. His figure shows narrow cylindrical clavae, with an intercalary region bearing crowded, superficial perithecia. The ascospores are cylindrical, attenuated towards the ends, 40–63 × 2–2·5 μ, 7–8-septate, not dividing into part-spores. His ascription of the name to Ellis and Seaver is probably due to Lloyd's statement on p. 912: 'We recently looked over the *Cordyceps* material at the New York Botanical Garden, where are preserved the specimens on which Ellis and Seaver, for the most part, based their work.' But Seaver did not mention *Cordyceps Gryllotalpae* in his *Hypocreales of North America*,

from which it may be deduced that the Louisiana specimens were not then in the herbarium.

Whether *Cordyceps Gryllotalpae* is to be attributed to Curtis or Lloyd must be left to experts in nomenclature. But the Japanese fungus is an *Ophiocordyceps*, and should stand as *Ophiocordyceps Gryllotalpae* (Kobayasi) Petch n.comb.

In *Trans. Brit. Myc. Soc.* XIX, 173 (1935) I recorded *Cordyceps amazonica* P. Henn. on a mole cricket from Trinidad, collected by Mr Stell in January 1925. In this specimen the clavae are fasciculate, two mature and one initial arising together from the insect, the height of the largest being about 2 cm. The stalk is pale brown, rough, terete, up to 2 mm. diameter below, 1·5 mm. above, and each mature clava has a short sterile branch a little distance below the head. The head is globose or ovoid, regular, sharply defined from the stalk, about 2·5 mm. diameter, red-brown, with dark brown, scarcely projecting ostiola. The head has a definite cortex, and the perithecia are immersed, perpendicular to the surface, narrow flask-shaped to elongated oval, 0·6 mm. high, 0·15 mm. diameter, crowded in a peripheral layer. The part-spores are cylindrical, ends rounded, 4·5–6 × 2–2·5 μ.

166. *Cordyceps citrea* Penz. & Sacc.

This species was described by Penzig and Saccardo from a specimen collected at the hill station, Tjibodas, in Java on the larva of a beetle. I have a specimen, kindly sent to me by Dr W. McRae, collected at Shembagunur, Pulnis (6000 ft.), Madras Presidency, May 1922, on a larva which appears to be that of a beetle.

The larva is about 8 cm. long and 1 cm. diameter, and is enclosed for the greater part of its length in a smooth white coat of mycelium, which suggests that it was situated in a boring in wood. Towards the head, numerous branching strands of mycelium arise from the external coat, and some of these terminate in perithecial clavae. The largest clava arises from a flattened strand about 2 mm. broad, which expands into a flattened palmate clava, 1·2 cm. broad, dividing above into four conoid heads, up to 1 cm. long, the total height of the clava being about 2 cm. Another strand terminates in a clavate head, 1·5 cm. long, 4 mm. diameter, and another in a cylindrical head, 4 mm. long, 2 mm. diameter. The mycelium is white, but the heads are lemon-yellow, closely dotted with brown ostiola. The perithecia are immersed, but the head has no definite cortex, and the apices of the perithecia become prominent on the older parts. The apex of the head is rounded. The perithecia are oval, attenuated above, with a truncate apex, 0·55–0·7 mm. high, 0·25–0·28 mm. diameter, crowded; and the asci are cylindrical, capitate, with cylindrical, truncate part-spores, 4–8 × 1 μ.

Penzig and Saccardo described and figured a clava with an erect, compressed stalk, 4–4·5 cm. high, branching at the apex, with short, erect, cylindrical or compressed branches, terminating in elliptic, obtuse heads, 5–10 mm. long. In the present specimen the mycelium divides below ground and does not produce a single main stem. A more important difference is in the size of the perithecia, which Penzig and Saccardo stated were very small, 250μ high, 90μ diameter. Their specimen was apparently not quite mature, as they did not give the dimensions of the part-spores, but that would scarcely account for the smaller dimensions of the perithecia. It would seem possible that there may have been some error in measurement.

167. *Calonectria coccidophaga* Petch

This species was described with coloured figures and line drawings in *Trans. Brit. Myc. Soc.* VII, 141–3, Pl. IV, figs. 1–4 and Pl. V, figs. 7 and 13, together with its conidial stage, *Discofusarium tasmaniense* (McAlp.) Petch, syn. *Microcera tasmaniensis* McAlp. In 1935, Dr O. Reinking asked me to send him a specimen for examination, and I accordingly sent him the specimen figured on Pl. IV, fig. 3. In his reply Dr Reinking wrote: 'After having made a study and drawings of the ascospores as well as accompanying *Fusaria*, Dr Wollenweber came to the conclusion that the fungus was identical with *Gibberella pulicaris* (*Fusarium sambucinum*). The lighter coloured base of the perithecia turned bluish black upon addition of an alkali which would indicate that this colour modification is merely dependent upon the reaction.' This synonymy was published by Wollenweber & Reinking in their book, *Die Fusarien.*

The dried perithecia of *Calonectria coccidophaga*, when detached from the yellow stroma, appear black above, but pinkish yellow below. From the colour of the perithecium when soaked in water, it is probably very dark red when fresh. The wall is minutely pruinose, except round the ostiolum, probably from adhering rubbish, as it is otherwise smooth and has a horny appearance; it is rigid, not collapsing, and does not become wrinkled or warted in drying. Internally the wall is entirely rose-red, but in section the outer layers are vinous or purple-red, while the inner layers are yellowish white. It is composed of small cells, obscurely parenchymatous, with an external amorphous film. The cells round the ostiolum are thick-walled, oval, 4–5 × 3–4μ, arranged concentrically. The wall is quite different from the coarsely parenchymatous, large-celled wall of *Gibberella pulicaris*. The ascospores are larger than those of the latter (22–34 × 8–9μ), not the same shape, and distinctly thick-walled.

The *Fusarium* stage has a thick, white, marginal wall of parallel hyphae surrounding a disk of conidiophores, the latter salmon-pink

when fresh, but yellowish when dry. It looks like a *Peziza*. No doubt the presence of the marginal wall caused McAlpine to place the fungus in *Microcera*, but it is not similar to the sheath of *Microcera*. The conidia are three to five septate, 44–58 × 5–6 μ. Its only resemblance to *Fusarium sambucinum* is in its conidiophore, which is of the same type as that of the latter.

I did not trouble to contradict Wollenweber and Reinking's identification, being confident that no one who collected the fungus again in Australia would regard it as *Gibberella pulicaris*. It has, however, been pointed out to me recently, in connexion with my paper, *British Hypocreales*, that it is not sufficient merely to ignore erroneous records or determinations, and that if not contradicted they are regarded as correct and continue to be cited. (Incidentally, that was the reason for the publication of several sections of my recent paper, *Further Notes on British Hypocreales*.) Consequently I must express my complete disagreement with the statement that *Calonectria coccidophaga* is *Gibberella pulicaris*.

168. **Calonectria truncata** Petch, n.sp.

This species was collected by Mr R. G. Fennah in St Lucia, B.W.I., 20 November 1939, on a leaf-hopper, and was kindly submitted to me by the Imperial Mycological Institute. The insect is covered by a thin layer of white mycelium, in which the perithecia are partly immersed. The perithecia are pale yellow, broadly flask-shaped or conoid, 0·1 mm. diameter, 0·25 mm. high, tomentose at the apex with short, erect or spreading, rigid hairs, which make the apex appear truncate. The asci are clavate, 85–95 × 14–15 μ, the apex being truncate when immature, but not thickened, and becoming rounded or subacute when mature. The ascospores are fusoid, sometimes attenuated below, seven to fourteen septate, hyaline, 40–50 × 7–9 μ. This species differs from *Calonectria Hirsutellae* in the shape and colour of the perithecia, the shape of the asci and the dimensions of the ascospores.

The mycelium bears elongated conoid *Hirsutella* phialides, 14–18 × 3–4 μ, with a short sterigma. This is *H. floccosa* Speare. In describing *Calonectria Hirsutellae*, its conidial stage was said to be *H. floccosa*, but a re-examination of that specimen shows that the identification was incorrect; its phialides have a flask-shaped base, 9–18 × 4–5 μ, with a stout sterigma, 1 μ thick, but complete sterigmata have not been observed and its identification is uncertain.

Calonectria truncata Petch, n.sp. Mycelio albo insectum obtegente; peritheciis in mycelio semi-immersis, pallide flavis, late ampullaceis vel conoideis, 0·1 mm. diam., 0·25 mm. alt., truncatis, apice crinibus brevibus rigidis rectis vel patentibus vestitis; ascis clavatis, octo-

sporis, 85–95 × 14–15 μ; ascosporis fusoideis, interdum infra attenuatis, hyalinis, 7–14-septatis, 40–50 × 7–9 μ. On leaf-hoppers, St Lucia, B.W.I.

169. *Torrubiella Blattae* Petch

This species, which occurred on the ootheca of a blattid, was collected by M. J. Vinson at Macabé, Mauritius, and was forwarded to me by M. Raymond Mamet.

The subiculum forms a somewhat definite, rather compact, white or cream-coloured patch, in which the perithecia are partly embedded. The perithecia are crowded, narrow flask-shaped or conoid, amber (when dry), darker at the apex, white tomentose below, glabrous above, 0·5 mm. high, 0·25 mm. diameter below. The wall is hyaline by transmitted light. The asci are long cylindrical, 3 μ diameter, and the ascospores linear, 0·75 μ diameter, multiseptate, with septa 4–6 μ apart. Part-spores were not observed.

A description of this species has been published in the *Mauritius Institute Bulletin*, II, 17 January 1941.

The type species of the genus *Torrubiella*, *T. aranicida* Boud., has no paraphyses. Those described by Boudier were immature asci, which have the usual capitate apex.

170. Pycnidia on Cicadae, etc.

When an entomogenous fungus attacks an adult insect, it may spread from the body to the wings and produce its fructifications on the latter. That occurs commonly in *Cordyceps tuberculata* (Lebert) Maire, *Hirsutella entomophila* Pat., and in most Entomophthoraceae. It is, however, rather surprising to find that the wings of certain insects are specifically mentioned as the habitat of several fungi. Spegazzini described *Phoma alicola* Speg. on the decaying wings of *Fidicina bonariensis* (Cicadae) in Argentina, Tassi described *Phoma Acridii* Tassi on the decaying wings of *Acridium peregrinum* in Italy, and Saccardo added *Phyllosticta Berlesiana* Sacc. on the wings of a dead *Cicada plebeja*, again in Italy. There is very little difference between the three descriptions. The pycnidia are described as lenticular or globoso-lenticular, and the structure of the pycnidium wall loosely parenchymatous, coarsely parenchymatous, and distinctly parenchymatous respectively, while the shape and dimensions of the pycnospores agree. *Phoma Acridii* was said to be near *Ph. alicola*. It would appear that all these three are the same species.

Septoria pterophila Sacc. was found on the decaying wings of *Cicada orni* in Italy, and *Vermicularia cicadina* Ell. & Kell. on the wings of a dead Cicada at Manhattan, North America. From the descriptions it would appear that these two are distinct species.

All these fungi were found on dead insects, and in three the wings were described as putrescent or putrid. It is probable, therefore, that they are not pathogenic, and it may be that they are merely common saprophytes on decaying animal matter.

171. **Hymenostilbe Aphidis** Petch, n.sp.

A *Hymenostilbe* on aphids was collected by Mr R. G. Fennah in Dominica, B.W.I., in January 1940, and was kindly forwarded to me by the Imperial Mycological Institute. The clavae are usually solitary, rufous brown, up to 2 mm. high, 0·1 mm. diameter, erect or suberect, straight or flexuose, equal or slightly thickened upwards, terete, minutely pruinose. They are clothed with a palisade layer of basidia, which are conoid, narrow flask-shaped, or subcylindrical, 12–18 × 4–6 μ, pale brown, with an abrupt, hyaline, stout, cylindrical sterigma, 3–6 × 1 μ. The conidia are narrow oval or fusoid, hyaline, smooth, 9–15 × 4–5 μ, with a short, truncate apiculus.

Hymenostilbe Aphidis Petch, n.sp. Clavis rufobrunneis, ad 2 mm. alt., 0·1 mm. diam., rectis vel flexuosis, aequalibus vel supra leniter incrassatis, teretibus, minute pruinosis; basidiis conoideis, vel anguste ampullaceis, vel subcylindraceis, pallide brunneis, 12–18 × 4–6 μ, sterigmate cylindraceo, hyalino, 3–6 × 1 μ; conidiis anguste ovalibus vel fusoideis, hyalinis, levibus, breviter apiculatis, 9–15 × 4–5 μ. On aphids, Dominica, B.W.I.

On the same specimen as the foregoing fungus is a *Hirsutella*, sometimes on the same aphis as a *Hymenostilbe* clava, sometimes alone on an aphis. The insects are overrun by hyphae, at first hyaline, becoming fuscous, varying in diameter from 2 to 6 μ, which extend from them to the leaf. These hyphae bear *Hirsutella* phialides, hyaline, elongated conoid, sometimes attenuated regularly from the base, sometimes passing into a thin sterigma for one-half or one-third of their length, with a total length of 30–65 μ, and a diameter of 4–5 μ at the base. They usually occur laterally on the hyphae, but are very variable. Sometimes a phialide forks equally, so that two appear to arise at the apex of a cylindrical base, 13–16 × 5 μ. Others may bear slender lateral sterigmata at varying heights. The mycelium and phialides form minute greyish tufts scattered over the insect, and in these it may simulate an irregularly branched conidiophore, up to 100 μ high, with a main stem 6 μ diameter at the base. The mycelium may also run over a *Hymenostilbe* clava and produce clusters of phialides on it. The spore cluster is oval, 10 × 8 μ, and the conidia are hyaline, cymbiform, 9 × 1·5–2·5 μ. This species is *Hirsutella Aphidis* Petch, *Naturalist*, 1936, p. 60, originally described from a specimen collected in England.

Several of the details of *Hymenostilbe Aphidis* suggest a comparison

with *Isaria acaricida* Pat. It appears possible that the latter may be a combination of the two species found in the present specimen, but that can only be decided by an examination of the type.

172. **Isaria (Beauveria) sphaerocephala** Petch, n.sp.

This species was collected at Peradeniya, Ceylon, in November 1912, on cocoons of *Thosea recta* Hmpsn. (Lepidoptera), one of the nettle grubs. The larva within the cocoon is covered with white mycelium, but only the clavae emerge. The latter when full grown have a stout simple stalk and a well-defined subglobose head. The stalk is up to 2·5 mm. high, 0·5 mm. diameter, expanding upwards, pruinose, cream-coloured or brownish, and the head is up to 2 mm. diameter, cream-coloured, farinose, appearing compact, but somewhat loose internally and composed of radial conidiophores. The conidiophores are 2·5μ diameter, and bear lateral and terminal clusters of phialides, oval, 3–4 × 2μ, or subglobose, 3μ diameter, with conidia on thin, *Beauveria*-like sterigmata. The conidia are hyaline, oval, 2–2·5 × 1–1·5μ, or globose, 1μ diameter, not readily separating from the sterigma.

Isaria Orthopterorum Petch has a slender, zigzag or branching sterigma, not catenulate spores as stated in the original description, but differs from the present species in the size and shape of its conidia.

Isaria sphaerocephala Petch, n.sp. Clavis pistilliformibus, pallide flavidis; stipitibus ad 2·5 mm. alt., 0·5 mm. diam., supra incrassatis, pruinosis, brunnescentibus; capitibus ad 2 mm. diam., subglobosis, farinaceis, ex conidiophoris radiatim compositis; conidiophoris 2·5μ diam., phialides in acervis lateralibus et terminalibus ferentibus; phialidibus ovalibus, 3–4 × 2μ, vel subglobosis, 3μ diam., in sterigmate tenui terminatis; conidiis lateralibus et terminalibus, hyalinis, ovalibus, 2–2·5 × 1–1·5μ, vel globosis, 1μ diam. On larvae of Lepidoptera, Ceylon.

173. *Isaria tenuipes* Peck

A redescription of this species, from American specimens, was published in *Trans. Brit. Myc. Soc.* xxi, 58 (1937). It occurs on lepidopterous pupae, and is similar in general appearance to *Spicaria* (*Isaria*) *farinosa*, but as a rule it is more feathery, and the arrangement of the phialides in spheres at the ends of simple hyphae makes the head more granular. The conidia are cylindrical or oblong-oval, 4–6 × 1·5–2μ. I have recently received specimens of this from Mr E. A. Ellis, collected on two occasions, 15 October 1938 and 8 August 1940, at Wheatfen Broad, Norfolk. This is the first record of this species for Britain, though I have always been looking for some other

species among the scores of *Isaria farinosa* from all parts of England which I have examined during the last ten years. I find, however, that I have European examples of *I. tenuipes* from M. N. Taymans, Turnhout, Belgium, which I misidentified at the time as *I. dubia* Delacr. M. Taymans informed me that this long-spored *Isaria* was the common form in his district, and that he had not found *I. farinosa*. He had found *I. tenuipes* in 1939 at Westerloo, twenty miles from Turnhout, and at Schooten, six miles from Antwerp. The arrangement of the phialides in *I. tenuipes* is similar to that in *I. ochracea* Boud., but the latter has larger conidia.

174. *Spicaria prasina* (Maubl.) Saw.

A specimen of this species, on a caterpillar attached to a leaf of a grass, was found by Mr E. A. Ellis at Wheatfen Broad, Norfolk, in August 1939. As far as I am aware, this is the first European record of this fungus.

In *Trans. Brit. Myc. Soc.* xi, 264 (1926), I pointed out that, with certain additional punctuation, the description of *Botrytis Rileyi* Farlow might be taken as that of a *Spicaria*, and that the type should be compared with *Spicaria prasina*. The transfer has since been made by Miss V. K. Charles in *Mycologia*, xxviii, 398 (1938), but I have not seen any statement that the essential comparison has been made.

175. *Spicaria gracilis* Petch

This species was described as *Coremium gracile* in *Trans. Brit. Myc. Soc.* xi, 260 (1926), and was transferred to *Spicaria* in *Notes on Entomogenous Fungi*, No. 45, *Trans. Brit. Myc. Soc.* xvi, 241 (1932). On further consideration, and a better knowledge of *Spicaria* (*Isaria*) *farinosa* as it occurs in Britain, I am of opinion that *S. gracilis* cannot be separated from the latter species. Like the latter it attacks insects of all kinds, but in general it does not occur in the isarioid form.

176. *Cephalosporium coccorum* Petch

This species was described as *Cephalosporium* (*Acrostalagmus*) *coccorum* in *Trans. Brit. Myc. Soc.* x, 171 (1925). Many of the species of *Cephalosporium* on insects produce *Acrostalagmus* conidiophores, often sparingly in nature but usually abundantly in culture. In the list of cultures issued by the Centraalbureau voor Schimmelcultures, Baarn, in 1936, this species is listed as *Verticillium coccorum*, and as reported in *Rev. App. Myc.* xvi, 677 (1937), P. Kotthoff in *Angew. Bot.* xix, 127–30, stated that Miss Westerdijk had transferred it to *Verticillium* because of its profuse verticillate branching in old cultures. But that branching was recognized in the original naming, and the transference, if any were needed, should have been to *Acrostalagmus*.

177. *Cephalosporium aphidicola* Petch

Dr C. E. Foister sent me this species in February 1939, on the aphis, *Capitophorus fragariae*, on strawberry, presumably grown under cover, from Auchincruive, Scotland. It was originally described in *Trans. Brit. Myc. Soc.* XVI, 71 (1931), from Ceylon specimens. The conidia in the Scottish examples are oblong or oblong-oval, sometimes slightly curved, $4–8 \times 1{\cdot}5\mu$, as against $5–9 \times 1{\cdot}5–2\mu$ in the type. In *Trans. Brit. Myc. Soc.* X, 175 (1925), reference was made to *C. Lefroyi* Horne, described in *Gard. Chron.* LVII, 139 (1915), on *Aleyrodes vaporariorum* on *Centropogon*, a greenhouse plant, at Wisley. Its conidia were given as ellipsoid, ovoid, or oblong, straight or slightly curved, $\pm 7 \times 1–1{\cdot}7\mu$. No specimens were preserved, and it has not been reported again. There would appear to be some probability that the two species are the same, notwithstanding the host difference, but the question must be left in abeyance until the re-discovery of specimens on *Aleyrodes*.

178. **Cephalosporium subclavatum** Petch, n.sp.

A diseased caradrinid larva (Lepidoptera), kindly forwarded by Mr J. C. F. Fryer, was found to be attacked by an undescribed species of *Cephalosporium*. When received, the larva was sparsely covered by loose greyish white mycelium bearing scattered lateral conidiophores, but on keeping it in a damp chamber it developed a dense white covering, tomentose with conidiophores, and ultimately in places a luxuriant fluffy growth. The conidiophores on the original sparse mycelium were lateral, simple, subulate, $12–18\mu$ high, $1{\cdot}5\mu$ diameter at the base, tapering uniformly to the apex, with conidia $4–7 \times 1{\cdot}5–1{\cdot}75\mu$. In the more developed growth, *Acrostalagmus* conidiophores were produced, up to 400μ high, $2–3\mu$ diameter at the base, septate, with whorls of three to six branches in the upper part, the branches being 2μ diameter below, $20–25\mu$ long, subulate, tapering uniformly, with heads of conidia about 10μ diameter. The conidia were irregularly placed in the head, not parallel, and were oblong-oval or narrow-oval, the longer subclavate, ends obtuse, $4–8 \times 1{\cdot}5–2\mu$.

Cephalosporium (*Acrostalagmus*) *subclavatum* Petch, n.sp. Mycelio albo insectum obducente; conidiophoris simplicibus, lateralibus, subulatis, $12–18\mu$ alt., basi $1{\cdot}5\mu$ diam., vel ramosis, ad 400μ alt., basi $2–3\mu$ crass., supra verticillis 3–6 ramorum, $20–25\mu$ long., basi 2μ crass.; conidiis oblongo-ovalibus, angusto-ovalibus, vel subclavatis, obtusis, $4–8 \times 1{\cdot}5–2\mu$. On larvae of lepidoptera, Britain.

179. *Sorosporella* and *Syngliocladium*

Among a collection of diseased wireworms (*Agriotes* sp.) recently sent me by Mr H. C. Gough, Rothamsted, were several attacked by what I believe to be *Sorosporella uvella* (Krass.) Giard. The larvae were

completely filled with a solid, white or pale brown mass of cells, either globose, 9μ diameter, or ovoid, 11–12 × 7–8μ, hyaline, sometimes with short projecting remnants of adjacent cells, but otherwise smooth. This is *Sorosporella*. On keeping the specimens moist, they produced short clavae, sometimes in a continuous fringe along the sutures. These clavae bear short *Gliocladium* conidiophores, with subulate phialides about 18μ long and 3μ diameter at the base, each conidiophore bearing a globule of hyaline ellipsoid conidia, 5–7 × 3–3·5μ. This is a *Synglíocladium*, and it is evidently the same as *Acremonium Cleoni* Wize, which was described from a juvenile condition and must now stand as *Syngliocladium Cleoni* (Wize) Petch. Both *Sorosporella uvella* (as *Tarichium*) and *Acremonium Cleoni* were originally described from specimens in and on the larvae of *Cleonus punctiventris*, a weevil which attacks sugar beet in Russia.

Tarichium uvella was described by Krassilstchik in 1886. Two years later, Sorokin described a similar fungus in lepidopterous larvae as *Sorosporella Agrotidis*. Giard noted the similarity of the two species, and united them under the name *Sorosporella uvella* (Krass.) Giard. But both names referred to a sclerotial or resting spore state, and now that another stage of each is known, it seems clear that the two fungi are different. Speare published a preliminary note on *Sorosporella uvella* in *J. Agric. Research*, VIII, no. 8, 189–94 (1917), and followed that with a fuller article in the same journal, XVIII, no. 8, 399–439 (1920), but his account deals with *Sorosporella Agrotidis*, not *S. uvella*. Speare was able to infect lepidopterous larvae with his fungus, but not coleopterous larvae. A full bibliography is given by Speare in his second paper.

Syngliocladium Cleoni has elongated conoid or subulate phialides about 18μ long, 3μ diameter below, and ellipsoid conidia, 5–7 × 3–3·5μ. Speare's figure of the conidial stage of *Sorosporella Agrotidis* is of a *Syngliocladium*, though he did not show the conidia united in heads; he gave the conidia as 9–11 × 4–6μ and the phialides as bottle-shaped or almost subulate. It should, however, be recorded that on a very young example of *S. Cleoni*, in which usually only one conidium was present on each phialide, the conidia were cylindrical or narrow-oval, with rounded ends, 6–13 × 1·5–3μ.

Both in *Sorosporella uvella* and *S. Agrotidis* the internal cells are said to occur in loose masses, like bunches of grapes. In the English specimens, the internal cells form a continuous solid mass, white when fresh, pale brownish when dry. It is possible that the mass may disintegrate when old, but that condition has not yet been observed.

In *Trans. Brit. Myc. Soc.* XXIII, 133 (1939), I described, but did not name, a *Syngliocladium* on the larva of a beetle, *Phyllophaga anxia* Lec., which occurred at Apple Hill, Ontario, in a cell underground. On re-examining that specimen, it was found that the larva was com-

pletely filled by a hard, solid sclerotial mass, chocolate-brown when dry, rather pale brown when soaked, composed of globose smooth cells, 9–11 μ diameter, budding like *Sorosporella* cells, and stout irregular hyphae, all hyaline by transmitted light. This is a *Sorosporella*, and, as in *S. uvella* and *S. Agrotidis*, it has a *Synglíocladium* conidial stage. As previously recorded, the *Synglíocladium* produces clavae or strands of mycelium from all parts of the larva, lax, white, minutely pruinose, about 0·25 mm. diameter, terete or flattened, the branches and main stems of the clavae apparently extending indefinitely, but generally broken in this specimen and entangled with one another. The conidiophores are about 20 μ high, and variable in structure; some bear phialides on prophialides, while in others the prophialides are absent, and all combinations of the two conditions occur. The phialides are narrowly flask-shaped or conoid, attenuated above, 7–12 × 1·5 μ, and the prophialides oblong, up to 6 × 2 μ. The conidia are oval, oblong-oval, or oblong with rounded ends, 2–3·5 × 1 μ, with a few globose, 1·5 μ diameter. In the account cited, I associated this species with an immature *Cordyceps* found on the same insect. That was apparently a mistake, as there is no evidence of a *Sorosporella* in the larvae which bear the *Cordyceps*. I name the *Synglíocladium*, *Syng. intricatum*.

Synglíocladium intricatum Petch, n.sp. Cellulae internae (alias *Sorosporella*) globosae, hyalinae, leves, sclerotium durum fusco-brunneum formanites; synnemata circa 0·25 mm. diam., laxa, alba, ramosa, intricata; conidiophorae breves, circa 20 μ alt., prophialides (praesentibus) oblongae, ad 6 × 2 μ, phialides angustae ampullaceae vel conoideae, supra attenuatae, 7–12 × 1·5 μ; sporae ovales, vel oblongo-ovales, utrinque rotundatae, 2–3·5 × 1 μ, interdum globosae, 1·5 μ diam.

A re-examination of the type of *Syng. aranearum* Petch, the type species of the genus, did not reveal any *Sorosporella*. The body of the spider, however, was broken before it was collected, and it is possible that any sclerotial mass may have fallen out.

180. *Acremonium*

Wize described three species of *Acremonium* on the larvae and chrysalides of a weevil, *Cleonus punctiventris* in Russia, viz. *Acremonium Cleoni*, *A. Danyszii*, and *A. soropsis*, with figures. In dealing with fungi parasitic on insects it has to be borne in mind that most stilboid species, e.g. *Hirsutella*, *Gibellula*, *Tilachlidium*, etc., produce conidiophores and conidia on repent hyphae as well as on clavae, or prior to the formation of the latter. Consequently it is necessary to be certain that one has the full-grown fungus, not merely a juvenile form.

Acremonium Cleoni is evidently a juvenile form. The figure shows a single immature conidiophore growing from a cluster of *Sorosporella* cells. As already stated, the full-grown form is a *Syngliocladium*, which must stand as *Syngliocladium Cleoni* (Wize) Petch.

Acremonium Danyszii, from the figure, is evidently an early stage of a *Hirsutella*, probably *H. Eleutheratorum* (Nees) Petch, which is not uncommon on larvae of coleoptera.

Acremonium soropsis, represented and described as producing brown masses of cells on the exterior of the insect, is probably a *Synnematium*.

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LIST OF DISEASES OF ECONOMIC PLANTS RECORDED IN SCOTLAND

By R. W. G. DENNIS and C. E. FOISTER

(*Seed Testing, Plant Registration and Plant Pathology Station, Corstorphine, Edinburgh*)

(With 1 Text-figure)

A first list of fungus diseases of economic plants received by the Plant Pathological Service for Scotland was published by Alcock and Foister in 1931 (**7**, xxx, 338). The present list incorporates the additional records which have accumulated during the succeeding decade, supplemented by reports by competent officers on the staffs of the Agricultural Colleges, whose assistance is hereby gratefully acknowledged. Our knowledge of the microfungi of Scotland is based largely on the enthusiastic pioneer work of a small body of collectors like Boyd, Keith and Trail. Their published lists have been drawn upon freely, though their usefulness is reduced by the frequent absence of any mention of the host plants concerned. The same applies to the records of the forays of the British Mycological Society in Scotland and those of the Cryptogamic Society of Scotland. A comprehensive account of the Scottish Rust Fungi by Wilson (**7**, xxxi, 345) is the source of many of the records of rusts of economic plants. Many of the records of heteroecious rusts contained therein are valueless for the present purpose, however, for they do not indicate which host was found to be diseased in a particular locality. The list of diseases of trees is drawn largely from papers in the *Transactions of the Royal Scottish Arboricultural Society* and the *Scottish Forestry Journal*. Strictly phytopathological papers are scarce, however, in Scottish literature, and it would appear that Scotland has never produced a notable plant pathologist.

The known distribution of the diseases is indicated in relation to the main drainage areas as laid down for *Insecta Scotica* (**1**, i, 161); these areas are indicated on the accompanying map. Diseases, the presence of which in Scotland has been verified by one of us, are indicated by an asterisk. The English system of a number of provincial mycologists reporting to a central laboratory has not been adopted in Scotland, with the result that information on the distribution of diseases is difficult to obtain. There seems to be a tendency to overlook the importance of diseases of the main agricultural crops, and most of the problems referred to the Plant Pathological Service relate

Fig. 1. Map showing the regions used in indicating the distribution of plant diseases in Scotland.

to horticultural crops, especially tomatoes and fruit. There can be little doubt that more could be done to prevent crop failures and losses if the interest of the agricultural community could be more extensively aroused in such practices, amongst others, as the routine disinfection of cereal seed and the dipping of potato tubers to prevent Dry Rot, Skin Spot and Blight. Indications of the losses caused by a few of the more important diseases of Scottish crops are given in a recent paper by Foister (**19**, xxiii, 168).

The distribution of the available records is as follows:

Solway	194	Dee	224	Sutherland	30
Tweed	164	Moray	251	Orkney	21
Forth	516	Argyll	78	Zetland	2
Clyde	475	Ross	56	Hebrides	3
Tay	341				

Even for the well-worked areas Forth and Clyde, the lists could doubtless be greatly extended, particularly in the sections dealing with forage crops and trees. As regards the other areas the above figures merely indicate the striking necessity for a fuller plant pathological service over the greater portion of the country. The distribution of a parasitic fungus is dependent on that of its host, at least in obligate parasites, and will accordingly fluctuate according as a given crop is more or less widely grown. Many of the more important fungi are seed-borne or are carried by the parts of plants used in vegetative propagation, and may therefore be expected to appear wherever their hosts are found, provided the environmental conditions are not too unfavourable to the growth of the parasite.

Comparison of the plant disease situation with that in England and Wales is difficult because the Ministry of Agriculture and Fisheries has not published a statement on crop diseases since 1932. Reference to the information available suggests that Scotland remains relatively free from a number of destructive plant diseases which are prevalent in England. Thus White Root Rot (*Rosellinia necatrix*) has not been reported, Violet Root Rot (*Helicobasidium purpureum*) is extremely rare, while rots due to *Sclerotinia sclerotiorum* are seldom encountered. All the downy mildews except *Peronospora parasitica* and *Phytophthora infestans* are also scarce.

On cereals, *Puccinia triticina*, *Ophiobolus graminis*, *Septoria Tritici*, *Dilophospora Alopecuri*, and *Rhynchosporium secalis* are either unknown or are seldom met with. Black Rot of Crucifers (*Pseudomonas campestris*) may occur in the field but seems never to have been authenticated. Plum Rust is scarce, while Sooty Blotch of Apple and Gnomonia Leaf Scorch of Cherry are not recorded. Strawberry diseases have been much studied in Scotland, but two fruit rots found in the south have not been met with, those due to *Septogloeum Fragariae* and *Phytophthora Cactorum*. Asparagus Rust (*Puccinia Asparagi*) has ap-

parently been extinct in Scotland since its discovery by Greville at Edinburgh in 1824.

Among diseases of ornamental plants so far unrecorded may be mentioned Brown Canker of Rose (*Diaporthe umbrina*) and Antirrhinum Shot Hole (*Heteropatella Antirrhini*).

While some of these diseases will probably be encountered in the future it appears probable that most of them do not occur here because environmental conditions are in some way unfavourable to them. Among the few diseases which have become established in the British Isles within recent years, some, like Elm Disease (*Ceratostomella Ulmi*), are well known to have failed to establish themselves north of the Border, whereas others have spread rapidly over the entire country. Thus Antirrhinum Rust, first recorded in England in 1933, was met with in Scotland in 1935 and has since been encountered in numerous localities, though it is too early to say if it is permanently established. Dahlia Leaf Spot, first collected in England in 1927, was recorded in Scotland in 1933 and is now common and widespread. On the other hand, *Puccinia mirabilissima* appears to have been first introduced from America into Scotland and to have spread thence to Wales, England and the European continent.

The lists include diseases caused by or associated with viruses, bacteria, fungi, eelworms and nutritional or physiological disturbances, listed in the above order. In practice, growers recognize as 'pests' pathogenic organisms large enough or active enough to be readily discernible by the unaided eye. Disorders due to all other agencies are classed as 'Diseases' and referred to the Plant Pathologist. Though fungi are associated with the majority of these troubles and are so recorded in this list, they are not always the primary cause of disease. Often, especially in disordered root systems, the primary cause of the disease is an environment unfavourable to the host. Remedial measures must then improve the environmental conditions, and attempts to control the disease by a direct attack on the fungus are unnecessary and useless. It follows, therefore, that the common description of plant pathology as 'Applied Mycology' is incorrect and misleading. This conception has hindered the progress of plant pathology by encouraging a complacent attitude on the part of the pathologist as soon as he has discovered an organism to be associated with a particular disease. It has had an even more disastrous effect on mycology by deflecting attention from the fungus as an end in itself, an object of beauty and a delight to the eye, and focusing it on the comparatively small number of fungi which are active parasites, plus a small group of facultative parasites associated with moribund tissues.

It follows that the fungus named in association with a particular disease cannot always be regarded with certainty as its primary cause.

Certainty can only be attained by reproduction of the disease under controlled conditions, using as inoculum pure cultures of the suspected organism. An Advisory Plant Pathologist has neither time nor facilities for such work. Fortunately for most important diseases there exists an experimental basis in the findings of research workers and institutes. There must always remain, however, many diseases of which the pathologist is able only to state his observations, leaving their interpretation open.

Our thanks are due more especially to Mr G. M. Stuart, Mr J. H. Moir, Mr D. S. Anderson, Prof. K. W. Braid and Prof. L. A. L. King, who have furnished us at regular intervals with reports on the diseases observed by them and their colleagues, and to the following authorities for the identifications indicated in the text: Dr K. M. Smith, Dr G. R. Bisby, Dr W. L. Gordon, Dr F. T. Bennett, Dr M. Wilson, Dr W. J. Dowson, Mr H. B. Bunting, Mr T. Petch, Miss E. M. Wakefield, Mr S. F. Ashby, and Dr G. H. Pethybridge. To the two last named we are particularly grateful also for ever-ready help and advice on innumerable problems, and especially in connexion with the identification of Phycomycetes. Finally, we are indebted to Mr W. C. Moore for criticizing the manuscript and for drawing our attention to a number of interesting records, including some from files inaccessible to us.

CEREALS

WHEAT

*Mildew	*Erysiphe graminis* DC.	Forth, Tay
*Take-all	*Ophiobolus graminis* Sacc.	Forth
*Ear Blight	*Gibberella Saubinetii* (Mont.) Sacc.	Forth (Det. F. T. Bennett)

Perithecia first recorded in 1939.

Ergot	*Claviceps purpurea* (Fr.) Tul.	Dee (A. S. Wilson, **1**, iii, 185)
*Bunt	*Tilletia caries* (DC.) Tul.	Tweed, Forth, Clyde, Tay, Dee

This disease has long been rare. Trail in 1891 (**1**, 3rd Ser. i, 33) could cite only a single record from personal experience; Boyd (**6**, N.S. iv, 25) had only one record in Ayrshire (1892) and cites only Greville's 1824 record for Forth (**9**, vii, 185). A specimen was received by us from Forth in 1938.

*Smut	*Ustilago Tritici* (Pers.) Rostr.	Forth, Clyde, Tay, Dee, Moray
*Black Rust	*Puccinia graminis* Pers.	Tweed, Forth

Berberis vulgaris is a frequent hedge plant in these two areas.

*Yellow Rust	*Puccinia glumarum* (Schm.) Erikss. & Henn.	Forth, Tay
Brown Rust	*Puccinia triticina* Erikss.	Tweed (Wilson, **7**, xxxi, 398)

A single record from Coldingham.

*Glume Blotch	*Septoria nodorum* Berk.	Tweed, Forth, Clyde, Tay, Moray
*Ear Blight	*Fusarium culmorum* (W.G.Sm.) Sacc.	Forth
*Leaf Stripe	*Helminthosporium sativum* Pamm., King & Bakke	Clyde

WHEAT (*continued*)		
*Black Mould	*Cladosporium herbarum* (Link) Fr.	Forth
*Black Point	*Alternaria* sp. (? *A. Peglioni* Curzi)	In samples of grain received at the Seed Testing Station
*Ear Cockle	*Anguillulina tritici* (Steinb.) Gerv. & v. Ben.	Forth, Tay
OATS		
*Mildew	*Erysiphe graminis* DC.	Forth, Clyde
*Leaf Stripe and Pre-emergence Blight	*Pyrenophora Avenae* Ito & Kuribay	Tweed, Forth, Clyde, Tay, Dee, Moray, Ross, Sutherland
Perfect stage recorded only from Clyde (Dennis, **3**, xix, 288).		
*Whiteheads	*Ophiobolus graminis* Sacc. var. *Avenae* E. M. Turner	Tweed
*Loose Smut	*Ustilago Avenae* (Pers.) Jens.	Solway, Forth, Clyde, Argyll, Tay, Moray, Ross, Sutherland, Orkney
Said by Boyd (**9**, vii, 185) in 1914 to be very common in Forth, now almost unknown in the lowlands.		
*Covered Smut	*Ustilago Kolleri* Wille	Moray
*Black Rust	*Puccinia graminis* Pers.	Solway, Tweed, Forth, Clyde
*Crown Rust	*Puccinia coronata* Corda	Forth, Clyde, Moray, Orkney
Particularly severe in 1933. As *Rhamnus* bushes are scarce in Scotland and there is evidence that the uredospores do not remain viable over winter, outbreaks probably originate from wind-blown spores from England or Ireland.		
*Leaf Spot	*Septoria Avenae* Frank	Tweed, Clyde
Ear Blight	*Fusarium culmorum* (W.G.Sm.) Sacc.	Dee
*Pre-emergence Blight	*Fusarium* sp. (seed borne)	Moray
*Grey Speck	Manganese deficiency	Forth, Clyde, Tay, Dee
Usually induced by heavy, uneven application of lime to the soil.		
*Tulip Root	*Anguillulina dipsaci* (Kühn) Gerv. & v. Ben.	Forth, Tay, Moray, Orkney
BARLEY		
*Mildew	*Erysiphe graminis* DC.	Tweed, Forth, Tay
*Whiteheads	*Ophiobolus graminis* Sacc.	Forth
*Ergot	*Claviceps purpurea* (Fr.) Tul.	Forth, Dee, Moray
*Loose Smut	*Ustilago nuda* (Jens.) Rostr.	Forth, Tay, Dee, Moray
*Covered Smut	*Ustilago Hordei* (Pers.) Lagerh.	Moray. Plowright records '*U. segetum* var. *tecta*' on barley in Iona
*Rust	*Puccinia simplex* Erikss. & Henn.	Tweed, Forth
Yellow Rust	*Puccinia glumarum* (Schm.) Erikss. & Henn.	Tweed, Tay (W. G. Smith, **19**, v, 414)
*Net Blotch	*Helminthosporium teres* Sacc.	Tweed, Forth, Tay
*Leaf Stripe	*Helminthosporium gramineum* Rabenh.	Forth, Clyde
**Rhynchosporium Secalis* (Oud.) Davis, though not yet received on barley, has occurred on *Bromus* sp. in Forth.		
RYE		
*Ergot	*Claviceps purpurea* (Fr.) Tul.	Forth, Argyll, Dee
*Black Rust	*Puccinia graminis* Pers.	Solway, Tay
*Rust	*Puccinia secalina* Grove	Forth, Tweed, Tay

ROOTS

POTATO		
*Leaf Roll	Solanum Virus 14 K. M. Smith	The distribution of these potato viruses is discussed by Cockerham (**19**, xxii, 1)
*Mosaic	Solanum Virus 1 K. M. Smith	
	Solanum Virus 3 K. M. Smith	
*Severe Mosaic	Solanum Viruses 1 and 3	
*Leaf-drop Streak	Solanum Virus 2 K. M. Smith	

POTATO (*continued*)

*Top Necrosis (of King Edward and Kerr's Pink)	Probably Solanum Viruses 1 and 3 respectively Very seldom seen in the field	Forth, Tay
*Net Necrosis	Solanum Virus 14 K. M. Smith	

This is a tuber symptom associated with Leaf Roll in the first year of infection and in certain varieties only. Common in Golden Wonder, also recorded in Kerr's Pink.

*Blackleg	*Bacterium phytophthorum* (Appel) Stapp	Solway, Forth, Clyde, Tay, Moray, Ross, Sutherland, Argyll, Hebrides
*Common Scab	*Actinomyces scabies* (Thaxt.) Güss.	Solway, Forth, Clyde, Tay, Dee, Moray, Ross, Sutherland, Hebrides
*Powdery Scab	*Spongospora subterranea* (Wallr.) Lagerh.	Tweed, Solway, Forth, Clyde, Tay, Moray, Ross, Sutherland
*Wart Disease	*Synchytrium endobioticum* (Schilb.) Perc.	Tweed, Solway, Forth, Clyde, Tay, Ross, Sutherland

Owing to the restriction in planting of wart-susceptible varieties, fresh outbreaks of this disease are rare. Since 1931 sixteen have occurred on holdings and 115 in private gardens or allotments. Details of the infected areas are given in an appendix to the Wart Disease of Potatoes (Scotland) Order of 1938.

*Watery Wound Rot	*Pythium ultimum* Trow	Forth, Clyde, Tay
*Blight	*Phytophthora infestans* (Mont.) de Bary	

Universally distributed in most years and still the main cause of losses in stored potato tubers. The cause of famine throughout the Hebrides and in the coastal districts from Ardnamurchan northwards in 1846.

*Pink Rot	*Phytophthora erythroseptica* Pethybr.	Forth, Clyde, Sutherland
*Stalk Break	*Sclerotinia sclerotiorum* (Lib.) de Bary	Clyde, Tay, Dee
*Black Scurf and Stem Canker	*Corticium Solani* Bourd. & Galz.	Solway, Forth, Clyde, Tay, Moray, Ross, Argyll
Violet Root Rot	*Helicobasidium purpureum* (Tul.) Pat.	Forth, Tay
Tuber Rot	*Armillaria mellea* (Vahl) Fr.	Forth (Wilson, **17**, xxxv, 186)
*Gangrene	*Phoma foveata* Foister	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray
*Black Dot	*Colletotrichum atramentarium* (B. & Br.) Taubenh.	Forth, Moray

This fungus is common on decaying haulm at the end of the season and was noted by Keith (**1**, ii, 308) in 1873–4. It is of little importance in the field but causes rotting of sprouts under the moist conditions of the laboratory test for wart disease.

*Dry Rot	*Fusarium caeruleum* (Lib.) Sacc.	Solway, Forth, Clyde, Tay, Dee, Moray
*Dry Rot	*Fusarium culmorum* (W.G.Sm.) Sacc.	Fife
*Grey Mould	*Botrytis cinerea* Pers.	Solway, Forth, Clyde
*Verticillium Wilt	*Verticillium albo-atrum* Reinke & Berth.	Forth, Clyde
*Skin Spot	*Oospora pustulans* Owen & Wakef.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Ross, Sutherland, Orkney

Also recently received on a tuber from the Faroe Islands.

*Silver Scurf	*Spondylocladium atrovirens* Harz	Forth, Clyde
*Potato Sickness	*Heterodera schachtii* Schmidt	

This pest is widely distributed in Scottish soils. Most of the records apparently relate to strains parasitic on clovers and grasses, but the potato race is well established in parts of Solway, Forth, Clyde and Tay.

*Stem Eelworm Injury	*Anguillulina dipsaci* (Kühn) Gerv. & v. Ben.	Clyde, Tay
*Spraing	Cause unknown, common in Arran Pilot	Tweed, Forth, Clyde, Moray, Sutherland
*Internal Rust Spot	Cause unknown	Solway, Forth, Clyde, Moray

POTATO (*continued*)

*Superficial pitting of tubers	Probably due to storage under bad conditions; *Cylindrocarpon radicicolum* Wr. associated. (Det. G.R. Bisby)	Forth, Dee, Moray

Somewhat similar lesions are sometimes caused by contact with artificial manures.

*Black Heart	Non-parasitic	Forth
*Hollow Heart	Non-parasitic	Forth
*Glassiness	Non-parasitic	Forth, Clyde
*Jelly-end Rot	Non-parasitic, common in Arran Pilot	Forth, Clyde, Dee

The above three troubles are associated with second growth.

*Leaf Spotting	Manganese deficiency	Forth
*Leaf Spotting	Cause unknown, *Alternaria* sp. associated	Forth, Moray

TURNIP AND SWEDE

*Mosaic	Brassica Virus 2 K. M. Smith	Forth
*Soft Rots	Various bacteria	Tweed, Solway, Forth, Clyde, Tay

A black pulpy bacterial rot commonly follows severe injury by larvae of the swede midge (*Contarinia nasturtii*). As a rule this does not penetrate beyond the neck and causes little loss, but it may occasionally assume alarming proportions, as in the Solway area in 1934. According to Lund the fluorescent bacterium associated with this type of rot in Denmark is *Bact. brassicaevorus* Delacroix. True Soft Rot of swede, in which the pulpy tissue is pale brown, seems to be associated mainly with injury to the root at or below soil level. From such tissue Dr Dowson has isolated organisms identified as *Bact. Aroideae* (Towns.) Stapp and *Pseudomonas medicaginis* var. *phaseolicola* (Burkh.) G. K. K. Link & Hull.

*Club Root	*Plasmodiophora Brassicae* Woron.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Ross, Sutherland, Orkney, Shetland
*Hybridization Nodules	Attributed to *Olpidium radicicolum* De Wildem.	Forth, Clyde
*Downy Mildew	*Peronospora parasitica* (Pers.) Tul.	Forth, Moray
White Blister	*Cystopus candidus* (Pers.) de Bary	Forth
*Mildew	*Erysiphe Polygoni* DC.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray
*Rhizoctonia Rot	*Corticium Solani* Bourd. & Galz.	Forth

This fungus has also caused 'damping off' of swede seedlings under glass.

*Dry Rot	*Phoma lingam* (Tode) Desm.	Solway, Forth, Clyde, Tay, Dee, Moray
*Botrytis Rot	*Botrytis cinerea* Pers.	Forth

Destroys a small number of roots in pits. The rot differs in colour and texture from that caused by *Phoma lingam*, the rotten tissue is paler and more spongy and the lesion is usually delimited by a pinkish line.

*Leaf Spot	*Gloeosporium concentricum* (Grev.) B. & Br.	Forth
*Brown Heart	Boron deficiency	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Ross

**Alternaria Brassicae* (Berk.) Bolle and *A. circinans* (Berk. & Curt.) Bolle cause rotting of seedlings in germination tests, but neither has yet been observed to cause disease in the field.

SUGAR BEET AND MANGOLDS

*Mosaic	Beta Virus 2 K. M. Smith	Forth
*Crown Gall	*Bacterium tumefaciens* E.F.Sm. & Towns.	Tay
Heart and Dry Rot	*Phoma Betae* (Oud.) Frank associated, but the trouble is doubtless due to boron deficiency	Forth

FORAGE CROPS

WHITE CLOVER		
Downy Mildew	*Peronospora Trifoliorum* de Bary	Solway (at Girvan, **4**, 1905), Clyde (Boyd, **6**, N.S. v, 162)
*Black Blotch	*Dothidella Trifolii* (Pers.) Bayl. Elliott & Stansf.	Solway, Tweed, Forth, Clyde, Tay
This fungus has been isolated from within Wild White Clover seed.		
Rot	*Sclerotinia Trifoliorum* Erikss.	Dee
S. Trifoliorum var. *minor* Alcock & Martin is frequently found in seed samples, but there is no evidence that it causes disease. There seems no reason to connect it with *S. Trifoliorum* Erikss., and Pape, **20**, xxii, 187, regards it as a distinct species, as yet unnamed.		
*Leaf Spot	*Pseudopeziza Trifolii* (Biv.-Bern.) Fuckel	Solway, Forth, Clyde, Tay, Dee, Moray
Recorded on the ornamental form '*Trifolium purpureum*' at Girvan, Solway (**4**, 1905).		
*Rust	*Uromyces flectens* Lagerh.	Forth, Clyde, Tay, Dee, Moray, Ross, Sutherland
Rust	*Uromyces Trifolii-repentis* Liro	Solway, Tay, Clyde (Wilson, **7**, xxxi, 360)
Leaf Spot	*Stagonospora compta* (Sacc.) Died.	Clyde (Boyd, **5**, v, 123)
Heterodera schachtii Schmidt has been recorded on this host in Clyde.		
RED CLOVER		
Downy Mildew	*Peronospora Trifoliorum* de Bary	Clyde (Boyd, **5**, ii, 93), Dee (Trail, **1**, N.S. iii, 81)
Recorded on *Trifolium medium* by us in Solway, by Boyd in Forth (**9**, vii, 183) and Clyde (**6**, N.S. iv, 29) and in Dee by Trail; on *T. minus* by Boyd in Clyde and on *Medicago lupulina* in Tay (Trail, **1**, N.S. iii, 81).		
*Mildew	*Erysiphe Polygoni* DC.	Forth, Clyde
Black Blotch	*Dothidella Trifolii* (Pers.) Bayl. Elliott & Stansf.	Moray (Keith, **1**, v, 9)
Also on *Trifolium medium* (Stevenson, **1**, N.S. i, 89) in Moray.		
*Leaf Spot	*Pseudopeziza Trifolii* (Biv.-Bern.) Fuckel	Forth, Clyde
Rust	*Uromyces Trifolii* Lév.	Moray (Wilson, **7**, xxxi, 360)
*Leaf Spot	? *Ascochyta Trifolii* Bond & Truss.	Tweed
*Scorch	*Kabatiella caulivora* (Kirchn.) Karak.	Forth, Clyde
Anther Blight	*Botrytis anthophila* Bond.	Clyde, fide J. H. Western
First reported, without locality, by Silow (**3**, xviii, 240).		
ALSIKE CLOVER		
*Mildew	*Peronospora Trifoliorum* de Bary	Forth
Leaf Spot	*Pseudopeziza Trifolii* (Biv.-Bern.) Fuckel	
*Sclerotia of *Typhula Trifolii* Rostr. occur in seed samples of Polish and Canadian origin, received at the Seed Testing Station. The fungus has not been encountered in the field.		
RYE-GRASS (*Lolium* spp.)		
*Mildew	*Erysiphe graminis* DC.	Forth, Clyde
*Blind Seed		Forth, Clyde, Dee
Caused by a Discomycete resembling *Stromatinia* (**21**, cxlvi, 492). The common saprophyte *Pullularia pullulans* (de Bary & Lw.) Berkh. is frequently associated with the parasite.		
*Ergot	*Claviceps purpurea* (Fr.) Tul.	Forth, Clyde, Dee
*Black Rust	*Puccinia graminis* Pers.	Clyde
*Rust	*Puccinia coronata* Corda	Forth, Clyde
*Leaf Spot	*Helminthosporium siccans* Drechsl.	Forth, Clyde
First collected in 1932, in Clyde.		
MEADOW GRASSES (*Poa trivialis* and *P. pratensis*)		
Mildew	*Erysiphe graminis* DC.	(Trail, **6**, N.S. iii, 13)
Ergot	*Claviceps purpurea* (Fr.) Tul.	Dee (A. S. Wilson, **1**, iii, 185)

MEADOW GRASSES (*Poa trivialis* and *P. pratensis*) (*continued*)

Rust	*Uromyces Poae* Rabenh.	Dee (Trail, **1**, N.S. iv, 305)
*Rust	*Puccinia Poarum* Niels	Solway, Forth, Clyde, Tay, Dee, Argyll, Moray, Orkney
Twist	*Dilophospora Alopecuri* (Fr.) Fr.	Dee (Trail, **1**, N.S. iii, 40)
*Leaf Spot	*Helminthosporium vagans* Drechsl.	Forth, Clyde
First collected in 1941.		
? Root Galls	(of *Poa annua*) *Protomyces Rhizobius* Trail	Dee (Trail, **1**, N.S. i, 125)

TALL FESCUE (*Festuca elatior*)

*Mildew	*Erysiphe graminis* DC.	Clyde
*Ergot	*Claviceps purpurea* (Fr.) Tul.	Clyde, Tay, Dee
*Rust	*Puccinia Phlei-pratensis* Erikss. & Henn.	Clyde
Rust	*Puccinia coronata* Corda	(Wilson, **7**, xxxi, 396)

MEADOW FESCUE (*Festuca pratensis*)

Ergot	*Claviceps purpurea* (Fr.) Tul.	Dee (A. S. Wilson, **1**, iii, 185)
Rust	*Puccinia graminis* Pers.	(Wilson, **7**, xxxi, 394)

RED FESCUE (*Festuca rubra* var. *arenaria*)

Leaf Spot (*Festuca rubra*)	*Phyllachora graminis* (Pers.) Fuckel	Solway (**4**, 1924), Moray (**4**, 1938)
According to Sampson and Western (**15**, 16) the species on this host is *Phyllachora sylvatica* Sacc. & Speg.		
Rust	*Puccinia Festucae* Plowr.	Argyll (Wilson, **7**, xxxi, 396)

SHEEP'S FESCUE (*Festuca ovina*)

*Choke	*Epichloe typhina* (Fr.) Tul.	Forth
Rust	*Puccinia Festucae* Plowr.	(Wilson, **7**, xxxi, 396)
Most published records of this rust are of *Aecidium Periclymeni* Schum.		
Rust	*Uredo Festucae* DC.	Tweed, Solway, Forth, Clyde, Argyll, Moray, Ross (Wilson, **7**, xxxi, 441)
*Leaf Galls	*Anguillulina graminis* (Hardy) Goodey	Forth

A leaf smut resembling *Ustilago striaeformis* (Westend.) Niessl has occurred on *Festuca* sp. in fine turf. Trail (**1**, N.S. iv, 277 and 370) recorded *Urocystis Agropyri* (Preuss) Schroet. on *Festuca arenaria* in Dee.

WATER WHORL GRASS (*Glyceria aquatica*) and FLOTE GRASS (*G. fluitans*)

Ergot (*G. fluitans*)	*Claviceps purpurea* (Fr.) Tul.	Dee (A. S. Wilson, **1**, iii, 185), Moray (**4**, 1938)
*Smut (both species)	*Ustilago longissima* (Sow.) Tul.	Forth, Clyde, Tay, Dee, Moray, Ross
*Leaf Spot (*G. fluitans*)	*Scolecotrichum graminis* Fuckel	Forth, Clyde

TIMOTHY (*Phleum pratense*)

*Ergot	*Claviceps purpurea* (Fr.) Tul.	Solway, Clyde, Dee
*Rust	*Puccinia Phlei-pratensis* Erikss. & Henn.	Clyde
*Leaf Spot	*Septoria oxyspora* Penz. & Sacc.	Tweed, Clyde, Dee

MEADOW FOXTAIL (*Alopecurus pratensis*)

*Ergot	*Claviceps purpurea* (Fr.) Tul.	Clyde, Dee
Also on *Alopecurus alpinus* var. *robustus* in Tweed (Fraser, **7**, xxviii, Proceedings, 12).		
Rust	*Puccinia graminis* Pers.	(Wilson, **7**, xxxi, 394)
Rust	*Puccinia perplexans* Plowr.	Dee (Trail, **1**, N.S. iv, 313)
A solitary record.		
Leaf Spot	*Mastigosporium album* Riess	Dee (Trail, **1**, N.S. iii, 41)

COCKSFOOT (*Dactylis glomerata*)

*Slime Disease	*Bacterium Rathayi* (E.F.Sm.) Stapp	Tay
*Mildew	*Erysiphe graminis* DC.	Forth, Clyde
*Leaf Spot	*Phyllachora graminis* (Pers.) Fuckel	Forth, Clyde
*Ergot	*Claviceps purpurea* (Fr.) Tul.	Solway, Clyde, Dee, Moray
*Choke	*Epichloe typhina* (Fr.) Tul.	Clyde, Tay
Smut	*Ustilago striaeformis* (Westend.) Niessl	Clyde (Boyd, **6**, N.S. iv, 25)
*Rust	*Uromyces Dactylidis* Otth	Tweed, Forth, Clyde, Tay
*Rust	*Puccinia coronata* Corda	Clyde
Black Rust	*Puccinia graminis* Pers.	Solway, Tay (**4**, 1924 and 1933)
*Leaf Spot	*Septoria oxyspora* Penz. & Sacc.	Clyde, Tay
*Leaf Spot	*Mastigosporium rubricosum* (Dearn. & Barth.) Sprague	Tweed, Forth, Moray

In the Clyde area close association has been observed between sporophores of *Psilocybe semilanceata* Fr. and isolated tussocks of cocksfoot planted out for seeding and surrounded by bare soil. The fungus was apparently living on the dead leaves at the base of the tussocks and caused no injury to the plants.

SWEET VERNAL GRASS (*Anthoxanthum odoratum*)

*Ergot	*Claviceps purpurea* (Fr.) Tul.	Clyde, Tay, Dee, Moray
Rust	*Puccinia Anthoxanthi* Fuckel	Solway, Dee (Wilson, **7**, xxxi, 401)
*Uredo Rust	*Uredo anthoxanthina* Bubák	Tweed, Solway, Forth, Clyde, Tay, Dee, Argyll, Moray, Ross, Sutherland

TALL OAT GRASS (*Arrhenatherum avenaceum*)

*Ergot	*Claviceps purpurea* (Fr.) Tul.	Forth, Dee
*Smut	*Ustilago perennans* Rostr.	Tweed, Forth
Rusts	*Puccinia graminis* Pers.	(Wilson, **7**, xxxi, 394)
	Puccinia coronata Corda	Forth (**4**, 1934)
	**Puccinia Arrhenatheri* Erikss.	Tweed, Solway, Forth, Clyde, Tay, Moray, Sutherland

BENTS (*Agrostis* spp.)

*Choke	*Epichloe typhina* (Fr.) Tul.	Forth, Tay
Leaf Spot	*Phyllachora graminis* (Pers.) Fuckel	Dee (Trail, **1**, N.S. iv, 279)
*Ergot	*Claviceps purpurea* (Fr.) Tul.	Forth
*Smut	*Tilletia decipiens* (Pers.) Körn.	Solway, Clyde, Argyll, Tay, Dee, Moray, Ross, Orkney, Shetland
Black Rust	*Puccinia graminis* Pers.	Solway (**4**, 1924)
Rust	*Puccinia coronata* Corda	Solway, Argyll, Orkney (Wilson, **7**, xxxi, 395)
Rust	*Puccinia Agrostidis* Plowr.	Solway, Tay, Dee, Moray (Wilson, **7**, xxxi, 403)
Twist	*Dilophospora Alopecuri* (Fr.) Fr.	Moray (**4**, 1938)
*Leaf Spot	*Mastigosporium rubricosum* (Dearn. & Barth.) Sprague	Forth
Leaf Spot	*Hadrotrichum virescens* Sacc. & Roum.	Clyde (Boyd, **5**, viii, 55), Moray (**4**, 1938), ? Dee (Trail, **1**, N.S. iii, 4, as *H. microsporum* var. *majus* Trail)
*Leaf Galls	*Anguillulina graminophila* Goodey	Clyde, Dee

HOLCUS spp.

*Ergot	*Claviceps purpurea* (Fr.) Tul.	Forth, Clyde, Dee
*Smut	*Ustilago striaeformis* (Westend.) Niessl	Forth, Clyde, Dee, Moray

HOLCUS spp. (*continued*)

*Smut	*Tilletia Holci* (Westend.) Schroet.	Forth, Moray
*Rust	*Puccinia holcina* Erikss.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Ross, Sutherland, Orkney

Elliott (12, 3rd Ser. xi, 85) records *Puccinia coronata* Corda on *Holcus*, presumably in error as this host is not listed by Wilson (**7**, xxxi, 395).

*White Tip	*Sclerotium rhizoides* Auersw.	Forth
*Twist	*Dilophospora Alopecuri* (Fr.) Fr.	Forth, Clyde, Dee, Moray
*Leaf Spot	*Ascochyta graminicola* Sacc.	Clyde
Leaf Spot	*Colletotrichum Holci* (Syd.) Grove	Clyde (**3**, vi, 369)

COUCH (*Agropyrum repens*)

Mildew	*Erysiphe graminis* DC.	Tweed, Forth, Clyde
Leaf Spot	*Phyllachora graminis* (Pers.) Fuckel	Forth (**4**, 1934)
*Choke	*Epichloe typhina* (Fr.) Tul.	Clyde
*Ergot	*Claviceps purpurea* (Fr.) Tul.	Clyde, Dee
Smut	*Ustilago striaeformis* (Westend.) Niessl	Dee (Trail, **1**, N.S. iii, 41)
*Smut	*Urocystis Agropyri* (Preuss) Schroet.	Forth
*Black Rust	*Puccinia graminis* Pers.	Tweed, Solway, Forth, Moray
*Rust	*Puccinia agropyrina* Erikss.	Tweed, Forth, Clyde, Tay, Dee
Rust	*Puccinia glumarum* Erikss. & Henn.	(Wilson, **7**, xxxi, 398)
Leaf Spot	*Septoria affinis* Sacc.	Dee (Trail, **1**, N.S. iii, 91)

HAIR GRASS (*Aira caespitosa*)

*Choke	*Epichloe typhina* (Fr.) Tul.	Tay
*Ergot	*Claviceps purpurea* (Fr.) Tul.	Moray, Dee
Black Rust	*Puccinia graminis* Pers.	(Wilson, **7**, xxxi, 394)
Rust	*Puccinia coronata* Corda	(Wilson, **7**, xxxi, 396)
*Rust	*Uredo Airae* Lagerh.	Solway, Forth, Clyde, Tay, Ross
Leaf Spot	*Scolecotrichum graminis* Fuckel	Moray

CRESTED DOGSTAIL (*Cynosurus cristatus*)

*Twist	*Dilophospora Alopecuri* (Fr.) Fr.	Clyde

QUAKING GRASS (*Briza media*)

*Black Rust	*Puccinia graminis* Pers. (Uredospores only). Det. M. Wilson	Tay

PURPLE MOOR GRASS (*Molinia caerulea*)

Choke	*Epichloe typhina* (Fr.) Tul.	Solway (Elliott, **12**, 3rd Ser. xi, 84)
Rust	*Puccinia Brunellarum-Molinae* Cruchet	Clyde, Tay, Moray, Ross, Argyll (Wilson, **7**, xxxi, 403)
Leaf Spot	*Septoria graminum* Desm. var. *Moliniae* Trail	Clyde (Trail, **1**, N.S. iv, 66)

MARRAM (*Psamma arenaria*)

*Ergot	*Claviceps purpurea* (Fr.) Tul.	Dee, Moray
Smut	*Ustilago hypodytes* (Schlecht.) Fr.	Dee (**1**, N.S. iv, 368), Moray (**4**, 1912)

Also on *Elymus arenarius* and *Agropyrum acutum* in Dee (**4**, 1931) and Tay (Trail, **1**, N.S. ix, 368).

*Rust	*Uredo ammophilina* Kleb.	Solway, Forth, Clyde, Dee, Moray, Ross, Sutherland

Claviceps purpurea (Fr.) Tul. is also on record on *Nardus stricta*, *Digraphis arundinacea*, *Lolium temulentum* and *Aira flexuosa*. For other diseases see records under 'Turf' in section dealing with ornamental plants.

VEGETABLES

TOMATO

*Mosaic and Yellow Mosaic	Strains of Nicotiana Virus 1 K. M. Smith	Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Sutherland

A strain causing extreme distortion of foliage is not uncommon in Clyde.

*Streak	Lycopersicum Virus 1 K. M. Smith or Solanum Virus 1 K. M. Smith plus Nicotiana Virus 1 K. M. Smith	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray

Both forms of streak occur and it is not known which is the more prevalent.

*Spotted Wilt	Lycopersicum Virus 3 K. M. Smith	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Orkney

First recorded in 1932 and still too common, especially in small nurseries.

*Brown Rot	*Bacterium phytophthorum* (Appel) Stapp	Clyde, Tay (Det. J. W. Dowson)
*Crown Gall	*Bacterium tumefaciens* E.F.Sm. & Towns.	Clyde
*Fasciated Shoots	Possibly *Bacterium fascians* (Tilford) Lacey	Clyde
*Damping Off and Foot Rot	*Phytophthora cryptogea* Pethybr. & Laff. and *P. parasitica* Dast.	Solway, Forth, Clyde, Tay

These fungi frequently also cause root rot of large plants which is quite distinct from the disease referred to below as Toe Rot. The 'Toe Rot' of English authors appears to be of the former type.

*Toe Rot	*Phytophthora verrucosa* Alcock & Foister	Forth, Clyde, Tay, Dee

First recorded in 1934: great loss may be caused by this disease. Complete loss of crop in a succession of large glasshouses is recorded.

*Buck-Eye Rot	*Phytophthora parasitica* Dast.	Forth, Clyde
*Blight	*Phytophthora infestans* (Mont.) de Bary	Tweed, Solway, Forth, Tay
*Sclerotinia Disease	*Sclerotinia sclerotiorum* (Lib.) de Bary	Clyde, Dee, Moray
*Foot Rot	*Corticium Solani* Bourd. & Galz.	Clyde, Tay
Violet Root Rot	*Helicobasidium purpureum* (Tul.) Pat.	Recent cultures from purple hyphal strands on tomato roots have yielded *Corticium Solani*.

Recorded in the previous list but has not been confirmed.

*Root Rot	*Colletotrichum atramentarium* (Berk. & Br.) Taubenhaus	Forth, Clyde, Tay
*Brown Root Rot	Associated with *Cylindrocarpon radicicolum* Wollenw., *Thielaviopsis basicola* (Berk.) Ferraris, *Pythium* spp. and other fungi	Forth, Clyde

In this disease the roots of well-established plants die back from the tip, the cortex turns brown, decays, and is readily pulled away from the vascular cylinder. It is probably due primarily to some soil condition not yet understood, though lack of aeration resulting from formation of surface pans is almost certainly an important factor.

*Fruit Rot	*Phoma destructiva* Plowr.	Forth, Clyde
Fruit Rot	*Alternaria Solani* (Ell. & Mart.) Sor., emend. Jones & Grout	Forth
*Fruit and Stem Rot	*Botrytis cinerea* Pers.	Forth, Clyde, Tay, Dee, Moray, Argyll

Fruit spotting due to this fungus also occurs occasionally.

*Wilt	*Verticillium albo-atrum* Reinke & Berth.	Forth, Clyde, Dee, Moray
*Wilt	*Fusarium bulbigenum* Cooke & Massee var. *Lycopersici* (Brushi) Wollenw. (Det. W. L. Gordon)	Dee

(According to the classification of Snyder and Hansen this is *Fusarium oxysporum* Schl. f. *Lycopersici* (Sacc.) Snyder & Hansen.)

*Leaf Mould	*Cladosporium fulvum* Cooke	Solway, Forth, Clyde, Tay, Moray, Argyll, Ross, Sutherland

The first Scottish record of this dangerous parasite appears to be that by Boyd (5, i, 52) from Hunterston, Clyde, in 1908.

TOMATO (*continued*)

*Root Knot	*Heterodera marioni* (Cornu) Goodey	Tweed, Forth, Clyde, Dee, Moray
*Sickness	*Heterodera schachtii* Schmidt	Forth, Clyde, Moray

First recorded on tomatoes in 1939, now well established in Midlothian and Lanarkshire.

*Blossom End Rot	Non-parasitic	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray
*Blotchy ripening and Greenback	Potash deficiency	Forth, Clyde, Tay, Moray
*Oedema	Non-parasitic	Forth, Clyde, Argyll, Moray

Sunscald of fruit and leaves is an occasional source of enquiry, as is variegation due to ammonium poisoning resulting from an overdose of Cheshunt Compound or other disinfectant containing ammonia or ammonium salts. Not infrequently damage is caused to the foliage by an excess of lime in the soil.

CUCUMBER

*Soft Rot	*Bacterium carotovorum* (L. R. Jones) Lehm	Forth
*Mildew	*Erysiphe Cichoracearum* DC.	Solway, Forth, Dee
Stem Rot	*Sclerotinia sclerotiorum* (Lib.) de Bary	Forth
Wilt	*Verticillium albo-atrum* Reinke & Berth.	Forth
*Anthracnose	*Colletotrichum lagenarium* (Passer.) Ell. & Hals.	Forth, Clyde, Dee
*Grey Mould	*Botrytis cinerea* Pers.	Forth
*Oedema	Non-parasitic	Tweed, Solway, Forth

VEGETABLE MARROW

Mildew	*Erysiphe Cichoracearum* DC.	Dee
Anthracnose	*Colletotrichum lagenarium* (Passer.) Ell. & Hals.	Clyde, Dee
*Grey Mould	*Botrytis cinerea* Pers.	Forth, Ross

PEA

*Mosaic	Probably Pisum Virus 2 K. M. Smith	Forth
*Root Rot	*Aphanomyces euteiches* Drechsl.	Solway, Forth, Clyde, Tay, Dee, Moray

Pythium spp. are sometimes associated with Foot and Root Rots.

*Downy Mildew	*Peronospora Viciae* (Berk.) de Bary	Forth, Clyde, Tay

Also on *Vicia sepium* in Forth (Boyd, **9**, vii, 183), Clyde (**5**, ii, 92), Dee (Trail, **1**, N.S. iii, 80) and Orkney (Trail, **1**, N.S. iv, 31); on *V. Cracca* in Moray (Keith, **1**, N.S. i, 271), on *V. sativa* in Dee (Trail, **1**, N.S. iii, 80) and Clyde (Boyd, **6**, N.S. iv, 29) and on *Lathyrus macrorhizus* in Dee (Trail, **1**, N.S. iii, 41).

*Mildew	*Erysiphe Polygoni* DC.	Solway, Forth, Clyde, Tay, Dee, Moray
*Foot Rot	*Mycosphaerella pinodes* (Berk. & Blox.) Vestergr.	Forth
*Foot Rot, Leaf and Pod Spot	*Ascochyta Pisi* Lib.	Solway, Forth, Clyde, Tay, Dee, Moray, Ross
*Foot Rot	*Fusarium Solani* Mart. var. *Martii* (App. & Wollenw.) Wollenw.	Forth
*Black Root Rot	*Thielaviopsis basicola* (Berk.) Ferraris	Tay
*Leaf Mould	*Cladosporium herbarum* (Link) Fr.	Forth, Tay

Not a parasite but sometimes an object of inquiry.

Stripe; cause not investigated, probably due to one or more viruses		Forth, Tay, Moray
*Marsh Spot	Manganese deficiency	Clyde

This disease is common in pea seed of English origin received at the Seed Testing Station and seriously reduces the vitality of the seed.

*Eelworm	*Heterodera schachtii* Schmidt	Forth

DWARF AND RUNNER BEAN

*Mosaic	Probably Phaseolus Virus 1 K. M. Smith	Clyde
*Bacterial Blotch	*Bacterium Medicaginis* (Sacc.) E. F. Sm. var. *phaseolicola* (Burkh.) G. K. K. Link & Hull	Forth, Clyde, Tay (Det. J. W. Dowson)
*Root Rot	*Aphanomyces euteiches* Drechsl.	Forth

Apparently the only record; the fungus on this host was indistinguishable morphologically from that on pea.

*Foot Rot	*Corticium Solani* Bourd. & Galz.	Clyde
*Anthracnose	*Colletotrichum Lindemuthianum* (Sacc. & Magn.) Bri. & Cav.	Solway, Clyde
*Root Rot	*Thielaviopsis basicola* (Berk.) Ferraris	Forth
*Red Nose	*Macrosporium commune* Rabenh.	Found in a seed sample at the Seed Testing Station

BROAD BEAN

*Rust	*Uromyces Fabae* (Pers.) de Bary	Tweed, Solway, Forth, Clyde, Argyll, Tay, Moray

This rust is also recorded on *Vicia Cracca, V. sativa, V. sepium* and *Lathyrus pratensis* by Trail (**1**, N.S. iv, 303).

*Chocolate Spot	*Botrytis cinerea* Pers.	Solway, Forth, Clyde, Tay, Ross
*Leaf Spot	*Ascochyta Fabae* Speg.	Forth

Fructifying on seed at the Seed Testing Station; probably best regarded as a variety of *Ascochyta Pisi* Lib.

CABBAGE, CAULIFLOWER, ETC.

*Cabbage Ring Spot	Brassica Virus 1 K. M. Smith	Forth

First recorded in 1939.

*Cauliflower Mosaic	Brassica Virus 3 K. M. Smith	Forth

First recorded in 1940.

*Black Rot	*Pseudomonas campestris* (Pamm.) E. F. Sm.	Det. W. J. Dowson

Found on rape grown in trial plot at East Craigs from Argentine seed.

*Soft Rot	*Bacterium carotovorum* (L. R. Jones) Lehm	Clyde
*Heart Rot	*Bacterium maculicola* McCulloch	Forth, Clyde
*Club Root	*Plasmodiophora Brassicae* Woron.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Moray, Ross, Sutherland
*White Blister	*Cystopus candidus* (Pers.) de Bary	Solway, Forth, Clyde, Tay, Moray

Races of this fungus are known in Scotland on *Barbarea vulgaris, Brassica arvensis, Capsella Bursa-pastoris, Cardamine flexuosa, C. hirsuta, Cochlearia officinalis, Sisymbrium officinale* (Trail, **1**, N.S. iii, 79), *Cardamine pratensis* and *Arabis alpina* (Boyd, **6**, N.S. iv, 28) in addition to the economic hosts cited on pp. 273, 282 and 287.

*Downy Mildew	*Peronospora parasitica* (Pers.) Tul.	Forth, Clyde, Tay

In addition to the hosts mentioned on pp. 273, 282, and 289 this fungus has been recorded in Scotland on *Brassica arvensis, Capsella Bursa-pastoris, Hesperis matronalis, Raphanus raphanistrum, Sisymbrium Alliaria* and *S. officinale* (Trail, **1**, N.S. iii, 81 and iv, 31).

*Mildew	*Erysiphe Polygoni* DC.	Solway, Forth

Also on marrow-stem kale.

*Black Leaf-Spot	*Mycosphaerella brassicicola* (Fr.) Lindau	Forth, Solway, Moray
*Wire Stem	*Corticium Solani* Bourd. & Galz.	Forth, Clyde, Moray

Usually on seedlings in seedboxes or frames.

*Canker	*Phoma lingam* (Tode) Desm.	Forth
*Leaf Spot	*Gloeosporium concentricum* (Grev.) B. & Br.	Forth, Clyde
*Grey Mould	*Botrytis cinerea* Pers.	Forth

Common on brussels sprouts in winter.

CABBAGE, CAULIFLOWER ETC. (*continued*)

*Oedema	Non-parasitic	Clyde
*Dwarfing	Cause unknown	Forth, Clyde

This disease was first encountered in 1940 in the variety Harbinger in Ayrshire. It is characterized by stunting of the plants as they approach maturity, accompanied by marked corrugation or 'quilting' of the lamina. The petioles of outer leaves bend upwards at almost a right angle near the base while the tips of the same leaves tend to curl downwards. There is no mottling of the leaves. Other varieties grown alongside remained normal. At the end of the year what seemed to be the same trouble was observed on cabbages which had begun to bolt on a Midlothian nursery. Numerous other varieties were found affected in 1941. A similar disease occurs on several hosts in Devon (**29**, xv, 4, 1938).

KOHL-RABI

Club Root	*Plasmodiophora Brassicae* Woron.	Solway

LETTUCE

*Mosaic	Lactuca Virus 1 K. M. Smith	Clyde
*Bacterial Spot	*Bacterium marginale* N. A. Brown	Forth, Clyde
*Downy Mildew	*Bremia Lactucae* Regel	Solway, Forth, Clyde

This fungus is rare on lettuce, but a morphologically identical form is common on native Compositae including *Sonchus asper* (Boyd, **6**, N.S. iv, 29), *Senecio sylvaticus* (Keith, **1**, N.S. i, 271), *S. vulgaris*, *S. Jacobaea*, *Taraxacum officinale*, *Sonchus oleraceus*, *S. arvensis*, *Cnicus lanceolatus* (Trail, **1**, N.S. iii, 80), *Cnicus arvensis*, *Hypochaeris radicata* and *Centaurea Scabiosa*. Cross-inoculations from the last named to lettuce gave negative results. Boyd (**5**, i, 52) has it also on the cultivated *Senecio elegans*.

*Seedling Root Rot	*Corticium Solani* Bourd. & Galz.	Forth
*Ring Spot	*Marssonina Panattoniana* (Berl.) Magn.	Forth, Clyde, Tay, Argyll
*Grey Mould and Red Leg	*Botrytis cinerea* Pers.	Forth, Clyde, Argyll, Tay
*Tip-burn	Non-parasitic	Clyde

ONION

*Soft Rot	*Bacterium carotovorum* (L. R. Jones) Lehm	Forth
*Downy Mildew	*Peronospora Schleideniana* W.G.Sm.	Forth, Clyde, Tay

First recorded by W. G. Smith in 1888.

*Smut	*Urocystis Cepulae* Frost	Tweed, Forth, Clyde

First recorded in 1912.

*White Rot	*Sclerotium cepivorum* Berk.	Tweed, Solway, Forth, Clyde
*Neck Rot	*Botrytis Allii* Munn	Forth, Clyde

LEEK

*White Tip	*Phytophthora Porri* Foister	Tweed, Forth, Clyde
*Smut	*Urocystis Cepulae* Frost	Tweed, Forth
*Rust	*Puccinia Porri* (Sow.) Wint.	Solway, Forth, Tay, Dee, Orkney

Also on *Allium Schoenoprasum* in Dee and Orkney (Trail, **1**, N.S. iv, 308), and on *A. vineale*. Another rust, *Caeoma Alliorum* Link, has been found once on leek in Clyde (Boyd, **6**, N.S. iii, Proceedings, 90).

*White Rot	*Sclerotium cepivorum* Berk.	Solway, Forth, Moray
*Pink Rot	*Fusarium* sp.	Forth

Conspicuous yellow striping of leek leaves, the cause of which is unknown, is occasionally reported from Forth.

SHALLOT

*Yellows	Cucumis Virus 1 K. M. Smith	Forth (Det. K. M. Smith)
*Downy Mildew	*Peronospora Schleideniana* W.G.Sm.	Tay
*Neck Rot	*Botrytis Allii* Munn	Solway, Moray

CELERY

*Soft Rot	*Bacterium carotovorum* (L. R. Jones) Lehm	Solway, Forth, Clyde

CELERY (*continued*)		
*Root Rot	*Pythium* sp.	Clyde
*Crown Rot	*Phoma apiicola* Kleb.	Solway
*Leaf Spot	*Septoria Apii* Chester	Solway, Forth, Clyde, Tay
Rust, *Puccinia Apii* Desm., has been recorded only once, in Tay (Trail, **1**, N.S. iv, 309), but the name 'Rust' is in common usage to describe brown markings on the petioles, such as result from slug or insect injury.		
PARSLEY		
Mildew	*Erysiphe Polygoni* DC.	Tay (**4**, 1933)
*Leaf Spot	*Septoria Petroselini* Desm.	Solway, Clyde, Tay, Dee, Moray
PARSNIP		
*Mildew	*Erysiphe Polygoni* DC.	Forth
Observed on parsnip 'seed' at the Seed Testing Station.		
*Canker. Primarily due to injury to roots by larvae of the carrot fly, *Cylindrocarpon radicicolum* Wollenw., associated		Solway
CARROT		
*Soft Rot	*Bacterium carotovorum* (L. R. Jones) Lehm	Forth
Recorded only in a consignment imported from Holland.		
*Black Rot	*Alternaria radicina* Maier, Drechsler & Eddy	Forth
RED BEET		
*Scab	*Actinomyces tumuli* Millard & Beeley	Solway, Forth, Clyde
*Leaf Spot	*Cercospora beticola* Sacc.	Forth
*Leaf Spot	*Phoma Betae* (Oud.) Frank, associated	Clyde
*Rust	*Uromyces Betae* Lév.	Dee, Moray
RHUBARB		
*Crown Rot	Ascribed to *Bacterium rhaponticum* Millard	Forth, Clyde
Leaf Spot	*Ramularia Rhei* Allesch.	Moray (**3**, xxiii, 303)
HORSE RADISH		
*White Blister	*Cystopus candidus* (Pers.) de Bary	Solway, Clyde, Forth, Dee
*Leaf Spot	*Ascochyta Armoraciae* Fuckel	Forth, Clyde
Leaf Spot	*Ramularia Armoraciae* Fuckel	Clyde (Boyd, **5**, v, 95)
MUSTARD AND CRESS		
Damping Off	*Pythium de Baryanum* Hesse	Forth
MINT		
*Rust	*Puccinia Menthae* Pers.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross
WATER CRESS		
Mildew	*Peronospora parasitica* (Pers.) Tul.	Forth, Clyde (Boyd, **7**, vii, 183; **6**, v, 162), Dee (**1**, N.S. iv, 276)
SALSIFY		
White Blister	*Cystopus cubicus* (Strauss) de Bary	Solway
MUSHROOM		
*White Mould	*Mycogone perniciosa* Magn.	Forth, Clyde
	Verticillium Malthousei Ware	Forth (Ware, **22**, xlvii, 763, citing Malthouse, **9**, iv, 182, 1901)
JERUSALEM ARTICHOKE		
*Stem Rot	*Sclerotinia sclerotiorum* (Lib.) de Bary	Forth

FRUIT

APPLE

*Fruit Rot	*Phytophthora Syringae* Kleb.	Moray
*Mildew	*Podosphaera leucotricha* (Ell. & Everh.) Salm.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray
*Canker	*Nectria galligena* Bres.	Solway, Forth, Clyde, Tay, Dee, Moray, Sutherland, Ross, Orkney
*Coral Spot	*Nectria cinnabarina* (Tode) Fr.	Forth, Tay
*Scab	*Venturia inaequalis* (Cooke) Wint.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Sutherland, Ross

Trail (**1**, N.S. ii, 229) has recorded the perfect stage in Dee and we have found immature perithecia in Forth.

*Blossom Wilt and Spur Canker	*Sclerotinia laxa* Aderh. & Ruhl. f. *Mali* (Worm.) Harrison	Solway, Forth, Tay
*Brown and Black Rot	*Sclerotinia fructigena* Aderh. & Ruhl.	Solway, Clyde, Tay, Moray, Ross
Silver Leaf	*Stereum purpureum* Pers.	?
*Blue Mould	*Penicillium expansum* Thom	Forth
*Eye Rot	*Botrytis cinerea* Pers.	Forth

On Cox's Orange Pippin purchased in Edinburgh but no doubt grown in England.

Fruit Rot	*Sphaeropsis Malorum* Berk.	Moray (Keith, **1**, iv, 346)
*Leaf Spot	*Phyllosticta* sp.	Clyde, Moray

Reported from Clyde in the previous list as *Phyllosticta solitaria* Ell. & Everh. Mr W. C. Moore, who has kindly examined the specimen from Moray, states that it is quite unlike *P. solitaria* and is evidently a secondary organism following Apple Scab. Boyd (in **4**, 1921) records *P. Briardi* Sacc. from Clyde; probably this refers to the same fungus.

*Leaf Scorch	Mainly potash deficiency	Clyde, Tay
*Glassiness	Non-parasitic	Forth

The following additional diseases have been encountered on imported apples:

*Bitter Rot	*Glomerella cingulata* (Stonem.) Spauld. & v. Schrenk	1931–3

The imperfect stage *Gloeosporium fructigenum* Berk. was noted on apple at Perth by White (**1**, v, 277).

*Black Rot	*Physalospora obtusa* (Schw.) Cooke	1931–2

PEAR

*Leaf Blister	*Taphrina bullata* (Berk.) Tul.	Tweed, Clyde, Moray
*Canker	*Nectria galligena* Bres.	Solway, Forth, Clyde, Tay, Dee
*Scab	*Venturia pirina* Aderh.	Solway, Forth, Clyde, Tay, Moray
*Blossom Wilt	*Sclerotinia laxa* Aderh. & Ruhl.	Forth, Tay
*Brown Rot	*Sclerotinia fructigena* Aderh. & Ruhl.	Solway
*Bitter Rot	*Glomerella cingulata* (Stonem.) Spauld. & v. Schrenk	Moray
Silver Leaf	*Stereum purpureum* Pers.	Tay
*Leaf Spot	*Septoria piricola* Desm.	Clyde
*Brown Heart	Non-parasitic	Forth
*Sleepiness	Non-parasitic	Tay, Moray

PLUM

*Bacterial Wilt and Canker	*Pseudomonas* sp., probably *P. morsprunorum* Worm.	Forth, Clyde, Tay
*Mildew	*Podosphaera Oxyacanthae* (DC.) de Bary var. *tridactyla* (Wallr.) Salm.	Moray

Also on *Prunus Padus* in Tay, Dee and Moray (Trail, **6**, N.S. iii, 11). *Uncinula prunastri* (DC.) Sacc. was recorded on '*Prunus*' by Boyd in Clyde (**5**, vii, 13) and on *P. spinosa* by Trail in Tay and Moray (**6**, N.S. iii, 15).

PLUM (*continued*)		
*Pocket Plums	*Taphrina Pruni* (Fuckel) Tul.	Solway, Forth, Dee, Moray
Also on *Prunus Padus* in Clyde (**5**, v, 130), Tay (White, **1**, v, 365), and Moray (**13**, 342), and on *P. spinosa* in Tweed (Hardy, **11**, x, 214) and Tay (White, **1**, v, 365).		
*Blossom Wilt, Wither Tip and Brown Rot	*Sclerotinia laxa* Aderh. & Ruhl.	Solway, Forth, Clyde, Tay, Moray, Ross
Also causing Wither Tip of wild *P. Padus* in Clyde.		
*Rust	*Puccinia Pruni-spinosae* Pers.	Forth, Tay, Moray
*Silver Leaf	*Stereum purpureum* Pers.	Forth, Clyde, Tay, Moray, Ross
Fomes Rot	*Fomes pomaceus* (Pers.) Lloyd	Clyde
*Die Back	*Cytospora leucostoma* (Pers.) Sacc., associated	Forth, Tay
Scab	*Cladosporium carpophilum* Thüm.	Tweed, Clyde
*Shot Hole	*Cercospora circumscissa* Sacc.	Dee
*Shot Hole	*Phyllosticta* sp.	Forth
Leaf Spot	*Cylindrosporium Padi* Karst.	Tay (**7**, xxvi, Proceedings, 21)
Gummosis	Associated with an excessive supply of nitrogen	Tay
CHERRY		
Mildew	*Podosphaera Oxyacanthae* (DC.) de Bary	Moray (**4**, 1927)
Witches' Broom	*Taphrina Cerasi* (Fuckel) Sadeb.	Clyde
Recorded on gean (*Prunus avium*) in Solway, 1939.		
*Leaf Curl	*Taphrina minor* Sadeb.	Clyde
*Brown Rot and Blossom Wilt	*Sclerotinia laxa* Aderh. & Ruhl.	Tweed, Forth, Clyde, Tay
Bitter Rot	*Glomerella cingulata* (Stonem.) Spauld. & v. Schrenk	Clyde
PEACH		
*Bacterial Wilt	Perhaps *Pseudomonas mors-prunorum* Worm.	Solway
*Mildew	*Sphaerotheca pannosa* (Wallr.) Lév. var. *Persicae* Woronich.	Solway, Forth, Clyde, Tay, Sutherland
*Leaf Curl	*Taphrina deformans* (Berk.) Tul.	Tweed, Solway, Forth, Tay, Moray
Also reported on *Prunus Avium* from Dee (Trail, **1**, N.S. iii, 42). See also Almond (p. 296).		
*Brown Rot	*Sclerotinia laxa* Aderh. & Ruhl.	Forth
*Brown Rot	*Sclerotinia fructigena* Aderh. & Ruhl.	Dee
*Silver Leaf	*Stereum purpureum* Pers.	Moray
*Shot Hole	*Clasterosporium carpophilum* (Lév.) Aderh.	Clyde, Tay
*Scab	*Cladosporium carpophilum* Thüm.	Clyde, Dee
NECTARINE		
*Mildew	*Sphaerotheca pannosa* (Wallr.) Lév. var. *Persicae* Woronich.	Tweed
*Silver Leaf	*Stereum purpureum* Pers.	Forth
*Gummosis	Non-parasitic	Tay
APRICOT		
*Canker	*Nectria cinnabarina* (Tode) Fr., associated	Forth
GOOSEBERRY		
*American Mildew	*Sphaerotheca mors-uvae* (Schw.) Berk.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross, Sutherland
Occurs on wild gooseberries in the hedges.		

GOOSEBERRY (*continued*)

*European Mildew	*Microsphaera Grossulariae* (Wallr.) Lév.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross
*Black Pustule	*Plowrightia ribesia* (Pers.) Sacc.	Forth, Moray
*Coral Spot	*Nectria cinnabarina* (Tode) Fr.	Clyde
Leaf Spot	*Pseudopeziza Ribis* Kleb.	? Solway
*Rust	*Puccinia Pringsheimiana* Kleb.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross, Sutherland
*Die Back	*Botrytis cinerea* Pers.	Tweed, Forth, Clyde, Tay, Moray, Ross

**Rhizoctonia* sp. (probably *Corticium Solani* Bourd. & Galz.) is sometimes associated with a similar condition. *Hendersonia Grossulariae* Oudem., recorded from Forth and Clyde in the previous list, is probably not a parasite. *Phomopsis pungens* Grove and one or more species of *Phoma* commonly occur on gooseberry shoots injured by other organisms including aphides.

*Leaf Spot	*Phyllosticta Grossulariae* Sacc.	Forth, Clyde
Leaf Spot	*Ascochyta ribesia* Sacc. & Fautr.	Clyde (Boyd, in **4**, 1921)

BLACK CURRANT

*Reversion	Ribes Virus 1 K. M. Smith	Tweed, Solway, Forth, Clyde, Argyll, Tay, Moray, Ross, Sutherland
*American Mildew	*Sphaerotheca mors-uvae* (Schw.) Berk.	Tay, Moray
Black Pustule	*Plowrightia ribesia* (Pers.) Sacc.	Forth, Dee
*Leaf Spot	*Pseudopeziza Ribis* Kleb.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee
*Leaf Spot	*Mycosphaerella Ribis* (Fuckel) Kleb.	Clyde, Tay, Dee, Moray, Ross
*Rust	*Cronartium ribicola* Fisch. de Waldh.	Solway, Tay, Moray

Recorded from Tay in 1910.

Root Rot	*Armillaria mellea* (Vahl) Fr.	Clyde
*Die Back	*Botrytis cinerea* Pers.	Solway, Forth, Clyde, Tay

RED CURRANT

*Black Pustule	*Plowrightia ribesia* (Pers.) Sacc.	Clyde
*Coral Spot and Die Back	*Nectria cinnabarina* (Tode) Fr.	Forth, Clyde, Dee
*Leaf Spot	*Pseudopeziza Ribis* Kleb.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Ross
Cluster Cup Rust	*Puccinia Pringsheimiana* Kleb.	Clyde
Rust	*Cronartium ribicola* Fisch. de Waldh.	Tweed, Clyde, Tay

A third rust, *Puccinia Ribis* DC., is known only from Keith's record, Moray, 1894 (**6**, N.S. iv, 287).

Die Back	*Botrytis cinerea* Pers.	Clyde

RASPBERRY

*Mosaic	Unidentified viruses	Solway, Forth, Clyde, Argyll, Tay, Moray, Ross, Sutherland
*Crown Gall	*Bacterium tumefaciens* E. F. Sm.	Tay
*Root Rot and Die Back	*Phytophthora Cactorum* (Leb. & Cohn) Schroet. var. *applanata* Chester	Forth, Clyde, Tay
Mildew	*Sphaerotheca Humuli* (DC.) Burr.	

This is probably the fungus referred to by Trail (**6**, N.S. iii, 15) as ? *Erysiphe Rubi* in Dee.

*Cane Spot	*Elsinoe veneta* (Burkh.) Jenk.	Forth, Clyde, Tay, Moray
*Spur Blight	*Didymella applanata* (Niessl) Sacc.	Forth, Clyde, Tay, Dee, Moray

First recorded in 1931.

*Cane Blight	*Leptosphaeria Coniothyrium* (Fuckel) Sacc.	Clyde, Tay
*Crown Rot	*Nectria mammoidea* Phill. & Plowr. var. *Rubi* (Osterw.) Weese	Forth, Clyde, Tay, Dee, Moray

RASPBERRY (*continued*)

*Rust	*Phragmidium Rubi-Idaei* (Pers.) Karst.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross
*Root Rot	*Armillaria mellea* (Vahl) Fr.	Forth

Rhizomorphs spreading from an infected stake attacked adjacent plants.

Leaf Spot	*Septoria Rubi* Westend.	Dee (Trail, **1**, N.S. iv, 281)
*Blue Stripe	*Verticillium Dahliae* Kleb.	Tweed, Forth, Clyde, Tay
*Die Back	*Fusarium* spp. associated	Forth, Clyde, Tay

This trouble is found in relatively exposed or high-lying plantations. At least one strain of *Fusarium avenaceum* (Fr.) Sacc. (Det. W. L. Gordon) has been isolated from dead shoots and shown to be able to kill raspberry buds. Usually, however, *Didymella applanata* is probably the primary parasite.

*Discoloration of Bark	*Botrytis cinerea* Pers.	Forth, Clyde
*Root Nodules	Cause unknown (see Wormald, **27**, 195)	Forth

STRAWBERRY

*Yellow Edge *Crinkle	Fragaria Virus 1 K. M. Smith Fragaria Virus 2 K. M. Smith	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Sutherland, Orkney

These two viruses are commonly found together and cause the most serious diseases of the strawberry.

*Fasciation	Perhaps *Bacterium fascians* (Tilford) Lacey	Clyde
*Red Core Root Rot	*Phytophthora Fragariae* Hickman	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Sutherland
*Mildew	*Sphaerotheca Humuli* (DC.) Burr.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray
*Leaf Spot	*Mycosphaerella Fragariae* (Tul.) Lind.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Argyll

Most records refer to *Ramularia Tulasnei* Sacc. but the perfect stage is known from Aberdeen (Trail, **1**, N.S. iii, 173).

*Leaf Spot or Scorch	*Marssonina Fragariae* (Sacc.) Kleb.	Tweed, Solway, Forth, Clyde, Tay
*Black Root Rot associated with the following fungi:		
	Cylindrocarpon radicicolum Wollenw.	Forth, Clyde, Tay
	Leptosphaeria Coniothyrium (Fuckel) Sacc.	Clyde
	Pezizella Lythri (Desm.) Shear & Dodge	Clyde

Primarily due to bad soil conditions, especially those which result from inadequate drainage. O'Brien and McNaughton (**23**, i) have suggested that under soil conditions unfavourable to the crop the strawberry mycorrhizal fungus may become parasitic.

Root Rot	*Armillaria mellea* (Vahl) Fr.	Forth
*Fruit Rot	*Corticium Solani* Bourd. & Galz.	Clyde
*Grey Mould	*Botrytis cinerea* Pers.	Tweed, Forth, Tay, Moray
*Red Plant	*Aphelenchoides fragariae* (Ritzema Bos) Goodey	Tweed, Solway, Forth, Clyde, Tay, Dee

Observed by Trail in Dee in 1891 (**2**, 1892, 79).

*Cauliflower Disease	*Aphelenchoides fragariae* (Ritzema Bos) Goodey	Forth, Clyde

This organism has been accepted as the cause but *Bacterium fascians* (Tilford) Lacey has been found to produce similar host reactions (see Lacey **24**, xxiii, 302).

*June Yellows	Non-parasitic	Forth, Clyde

GRAPE VINE

*Mildew	*Uncinula necator* (Schw.) Burr.	Tay
*Root Rot	*Armillaria mellea* (Vahl) Fr.	Clyde
*Grey Mould	*Botrytis cinerea* Pers.	Clyde
Leaf Spot	*Cercospora Roesleri* (Catt.) Sacc.	Tay (**25**, xv, 441, as *Cladosporium Roesleri* Catt.)

GRAPE VINE (*continued*)		
*Shanking	Non-parasitic	Forth
*Intumescences	Non-parasitic	Clyde
*Scald	Non-parasitic	Clyde
WALNUT		
Leaf Blotch	*Gnomonia leptostyla* (Fr.) Ces. & de Not.	Solway (Girvan, **4**, 1905), Tay (Trail, **1**, N.S. iii, 270)
*Fruit Rot	*Botrytis cinerea* Pers.	Moray
MELON		
*Soft Rot	*Bacterium carotovorum* (L. R. Jones) Lehm	Clyde
*Damping Off	*Phytophthora parasitica* Dast.	Tay

The following foreign fungi have been received on imported fruit:

**Diplodia natalensis* Pole-Evans, affecting 95% of a consignment of oranges from Jamaica.

**Penicillium digitatum* Sacc. and *P. italicum* Wehmer, on oranges.

**Aspergillus Tamarii* Kita and *Cephalosporium Bertholletianum* Spencer on Brazil nut.

**Macrophomina Phaseoli* (Maubl.) Ashby, on pea-nut.

ORNAMENTAL PLANTS

ABUTILON sp.		
*Mosaic	Abutilon virus 1	Forth
AGAVE sp.		
*Leaf Spot	*Coniothyrium concentricum* (Desm.) Sacc. var. *Agaves* Sacc.	Clyde
ALTHAEA ROSEA (Hollyhock)		
*Rust	*Puccinia Malvacearum* Mont.	Tweed, Forth, Clyde, Tay, Dee, Moray, Ross

Trail (**1**, N.S. iv, 367) gives the first Scottish record as Montrose (Tay) July 1890, but there is a record on Hollyhock by Keith from Forres in **1**, N.S. i, 270.

ANEMONE CORONARIA		
*Black Rot	*Sclerotinia tuberosa* (Hedw.) Fuckel	Tay
*Rust	*Puccinia Pruni-spinosae* Pers.	Forth, Clyde, Dee
ANEMONE JAPONICA		
*Yellow Ringspot	Cause unknown	Forth
ANTIRRHINUM MAJUS		
*Foot Rot	*Phytophthora* sp. and *Pythium* sp.	Dee
*Wilt	*Sclerotinia sclerotiorum* (Lib.) de Bary	Solway
*Rust	*Puccinia Antirrhini* Diet. & Holw.	Tweed, Forth, Clyde, Tay

First recorded in 1935; only slight local outbreaks have occurred.

*Collar Rot	*Corticium Solani* Bourd. & Galz.	Forth
*Leaf Spot	*Diplodina Passerinii* Allesch.	Forth, Clyde
*Leaf Spot and Stem Rot	*Phyllosticta Antirrhini* Syd.	Solway, Forth
*Wilt	*Verticillium* sp.	Tweed, Clyde
*Stem Rot	*Fusarium* sp.	Clyde
AQUILEGIA VULGARIS		
Rust	*Puccinia Agrostidis* Plowr.	Dee (Trail, **2**, ii, 188)
Leaf Spot	*Actinonema Aquilegiae* (Roum. & Pat.) Grove	Clyde (**3**, vi, 368)
ARABIS ALBIDA		
*White Blister	*Cystopus candidus* (Pers.) de Bary	Forth

ARMERIA sp. (Cultivated Sea Pink)		
Rust	*Uromyces Armeriae* Lév.	Forth (Wilson, **7**, xxxi, 359), Clyde (Boyd, **6**, N.S. ii, Proceedings, 8), Tay (White, **1**, vi, 41)
ASPARAGUS PLUMOSUS		
*Root Rot	*Pythium* sp.	Clyde
ASTER spp. (Michaelmas Daisy)		
*Mildew	*Erysiphe Cichoracearum* DC.	Forth
*Stalk Break	*Sclerotinia sclerotiorum* (Lib.) de Bary	Clyde
*Wilt	*Verticillium Vilmorinii* Westerd. & van Luijk	Solway, Forth, Tay
ATROPA BELLADONNA		
*Root Rot and Wilt	*Phytophthora erythroseptica* Pethybr. var. *Atropae* Alcock	Forth
AUCUBA JAPONICA		
Die Back	*Botrytis cinerea* Pers.	Clyde (Trapp, **3**, xx, 299)
AZALEA, see Rhododendron		
BARTONIA sp.		
*Damping Off	*Pythium complectens* Braun	Forth
BEGONIA spp.		
*Ring Spot	Lycopersicum Virus 3 K. M. Smith	Forth
*Leaf Spot	*Pseudomonas Begoniae* (Buchw.) Stapp	Forth, Clyde
*Damping Off	*Phytophthora* sp. and *Pythium* sp.	Forth
*Root Rot	*Corticium Solani* Bourd. & Galz.	Solway, Clyde
*Leaf Spot	*Gloeosporium Begoniae* Magn.	Forth
*Leaf Spot	*Phyllosticta Begoniae* Brun.	Forth
BERBERIS VULGARIS (Barberry)		
*Mildew	*Microsphaera Berberidis* (DC.) Lév.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray
*Rust	*Puccinia graminis* Pers.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Orkney
See also *Mahonia*.		
BUXUS SEMPERVIRENS (Box)		
Leaf Fall	*Guignardia Buxi* Desm. *Trochila Buxi* Capron	Forth Clyde, Tay, Moray
*Rust	*Puccinia Buxi* DC.	Solway, Forth, Tay, Dee, Argyll
CALCEOLARIA sp.		
*Wilt	*Phytophthora* sp.	Forth
CALENDULA sp.		
*Leaf Spot	*Entyloma Calendulae* (Oud.) de Bary	Forth
A form of this fungus has been recorded on *Hieracium vulgatum* in Tay and Dee (Trail, **1**, N.S. iv, 371) and on *H. vulgatum* and *H. sylvaticum* in Clyde (Boyd, **5**, vii, 10; **6**, N.S. iv, 26 and **4**, 1921).		
Rust	*Coleosporium Senecionis* Fr.	Dee; Fide W. C. Moore
CALLISTEPHUS CHINENSIS (Chinese Aster)		
*Wilt	*Phytophthora parasitica* Dast. & *P. cryptogea* Pethybr. & Laff.	Tweed
*Foot Rot	*Corticium Solani* Bourd. & Galz.	Tweed, Forth, Clyde
*Blackleg	*Fusarium conglutinans* Wollenw. var. *Callistephi* Beach	Forth, Clyde

CALLUNA VULGARIS vars. (Heather)

*Root Rot	*Armillaria mellea* (Vahl) Fr.	Clyde

The occurrence of *Fomes annosus* Fr. on heather in Dee is recorded in **14**, xli, 225.

*Die Back	*Clinterium obturatum* Fr. associated	Forth, Clyde, Argyll

An unidentified rhizomorphic fungus is also associated with this condition, as is the Heather Beetle, *Lochmaea suturalis*.

CAMPANULA spp.

Rust (*C. rotundifolia*)	*Puccinia Campanulae* Carm.	Clyde (**6**, N.S. iv, 126), Tay, Argyll, Dee (Trail, **1**, N.S. iv, 316)
*Rust (*C. rotundifolia*, *C. glomerata*, *C. persicifolia*)	*Coleosporium Campanulae* Lév.	Tweed, Forth, Clyde, Tay, Argyll, Dee, Moray
*Leaf Spot (*C. persicifolia*, *C. rotundifolia*)	*Ramularia macrospora* Fres.	Forth, Clyde, Dee
Leaf Spot (*C. latifolia*)	*Ramularia Campanulae-latifoliae* Allesch.	Clyde (Boyd, **5**, viii, 54)
Leaf Spot (*C. persicifolia*)	*Phyllosticta carpathica* Allesch. & Sydow	Clyde (Boyd, **5**, v, 121)
Leaf Spot (*C. rotundifolia*)	*Septoria obscura* Trail	Clyde (Trail, **1**, N.S. iv, 65)

CENTAUREA CYANUS (Cornflower)

*Rust	*Puccinia Cyani* Pass.	Clyde, Tay

Trail has a record of '*Puccinia suaveolens* var. *Centaureæ* Magnus on *Centaurea Cyanus*, public park at Aberdeen' (**1**, N.S. iv, 314).

CHEIRANTHUS CHEIRI (Wallflower)

*Breaking of Flower Colour	Probably Brassica Virus 1 K. M. Smith	Forth
*Club Root	*Plasmodiophora Brassicae* Woron.	Forth, Clyde, Ross
*Downy Mildew	*Peronospora parasitica* (Pers.) Tul.	Forth, Clyde, Ross
*Damping Off	*Pythium* sp. and *Rhizopus* sp.	Forth
*Foot Rot	*Corticium Solani* Bourd. & Galz.	Clyde

CHIONODOXA LUCILIAE

Smut	*Ustilago Vaillantii* Tul.	Forth (Boyd, **9**, vii, 185)

CHRYSANTHEMUM INDICUM

*Bronzing and Ring Spot	Lycopersicum Virus 3 K. M. Smith	Forth, Clyde
Crown Gall	*Bacterium tumefaciens* E. F. Sm. & Towns.	Clyde
*Root Rot	*Pythium megalacanthum* de Bary	Forth, Tay

When severe this rot also invades the basal shoots which would be used as cuttings. Onset of root rot in mature plants leads to malformation of flowers and failure of buds to open.

Rot	*Sclerotinia sclerotiorum* (Lib.) de Bary	Clyde (**25**, xiv, 559)
*Rust	*Puccinia Chrysanthemi* Roze	Solway, Forth, Clyde, Argyll, Tay
*Foot Rot	*Corticium Solani* Bourd. & Galz.	Forth
*Mildew	*Oidium Chrysanthemi* Rabenh.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Moray
*Blotch	*Septoria chrysanthemella* Sacc.	Forth, Clyde
*Leaf Spot	*Phyllosticta* sp. associated	Forth
*Verticillium Stem and Root Rot	*Verticillium* sp.	Forth
*Grey Mould and Bud Rot	*Botrytis cinerea* Pers.	Clyde

CHRYSANTHEMUM INDICUM (*continued*)

*Leaf-fall	*Aphelenchoides ritzema-bosi* (Schwartz) Goodey	Forth, Clyde, Tay

Yellowing caused by sodium chlorate poisoning, resulting from potted plants standing on paths recently treated with this substance as a weed-killer, is an occasional source of enquiry. (For a description of this condition see **24**, xxv, 659.)

CHRYSANTHEMUM MAXIMUM

Leaf Spot	*Septoria cercosporioides* Trail	Clyde (Boyd, **5**, v, 94)

CINERARIA sp.

*Foot Rot	*Phytophthora parasitica* Dast.	Forth
*Mildew	*Oidium* sp.	Tay (McDonald, **18**, 3rd Ser. cv, 111)
*Stem Rot	*Botrytis cinerea* Pers.	Forth

CLARKIA sp.

*Foot Rot	*Phytophthora Cactorum* (Leb. & Cohn) Schroet.	Solway, Tay

CLEMATIS sp.

*Root Injury	*Anguillulina pratensis* (de Man.) Goffart	Tweed

COTONEASTER sp.

*Root Rot	*Armillaria mellea* (Vahl) Fr.	Tay

CROCUS AUREUS

*Corm Rot	*Fusarium bulbigenum* Cooke & Mass.	Forth

CYCLAMEN sp.

*Crown Rot	*Botrytis cinerea* Pers.	Forth

DAHLIA spp.

*Mosaic	Dahlia Virus 1 K. M. Smith	Forth, Clyde
*Ring Spot	Lycopersicum Virus 3 K. M. Smith	Forth, Clyde, Tay, Moray
*Crown Gall	*Bacterium tumefaciens* E.F. Sm. & Towns.	Forth, Clyde
*Leaf Spot	*Entyloma Dahliae* Syd.	Solway, Forth, Clyde, Argyll, Tay

First recorded in 1933; now common and widespread.

*Leaf Spot	*Phyllosticta dahliicola* Brun.	Solway, Clyde
*Wilt	*Verticillium* sp.	Forth
*Grey Mould	*Botrytis cinerea* Pers.	Forth

DELPHINIUM spp.

*Leaf Spotting and Malformation	Lycopersicum Virus 3 K. M. Smith	Tweed (Det. K. M. Smith)
*Black Blotch	*Bacterium Delphinii* Bryan	Forth, Tay, Moray
*Root Rot	*Pythium* sp.	Clyde
*Mildew	*Erysiphe Polygoni* DC.	Solway, Forth, Clyde
*Leaf Spot	*Phyllosticta Ajacis* Thüm.	Clyde; first seen in 1935

DIANTHUS BARBATUS (Sweet William)

*Leaf Spot	*Didymellina Dianthi* C. C. Burt	Forth, Clyde, Moray, Argyll
Leaf Spot	*Septoria sinarum* Speg.	Dee (Trail, **1**, N.S. iii, 91 and 225)

DIANTHUS CARYOPHYLLUS (Carnation)

*Rust	*Uromyces caryophyllinus* Wint.	Clyde

First recorded by Boyd in 1909 (**5**, i, 111)

*Mildew	*Oidium* sp.	Forth
*Leaf Rot	*Heteropatella valtellinensis* (Trav.) Wollenw.	Forth

DIANTHUS CARYOPHYLLUS (Carnation) (*continued*)

*Wilt	*Verticillium cinerescens* Wollenw.	Clyde
*Root Rot	*Fusarium* sp.	Clyde
*Malformed Flowers	*Botrytis cinerea* Pers.	Forth
*Mould	*Cladosporium herbarum* (Link) Fr.	Clyde
*Eelworm Injury	*Anguillulina dipsaci* (Kühn) Gerv. & v. Ben.	Tay

Anther smut (*Ustilago violacea* (Pers.) Fuckel) has not yet been received on carnation but is common on *Lychnis alba, L. dioica, L. Flos-cuculi, Silene maritima, S. Cucubalus, S. nutans, Stellaria graminea* and *S. palustris* in Tweed, Forth, Clyde, Tay, Dee, Moray.

EREMURUS sp.

*Leaf Blotch	*Pullularia pullulans* (de Bary & Lw.) Berkh.	Forth

Primary cause probably frost.

EUPHORBIA sp.

Mildew	*Sphaerotheca tomentosa* Otth	Tay

FERNS

*Rust (*Aspidium* spp.)	*Milesina Kriegeriana* P. Magn.	Tweed, Forth, Clyde, Argyll, Tay, Moray

For other rusts of native ferns see Wilson (**7**, xxxi, 345) and Hunter (**3**, xx, 116).

*Root Rot (*Pteris Wimsetti*)	*Pythium* sp.	Tay
*Leaf Spots (*Pteris* spp. and *Davallia* sp.)	*Aphelenchoides olesistus* (Ritzema Bos) Goodey.	Forth

FICUS ELASTICA

Leaf Spot	*Gloeosporium elasticum* Cooke & Massee	Clyde (**6**, N.S. iii, Proceedings, 48)

FORSYTHIA SUSPENSA

Leaf Spot	*Phyllosticta Forsythiae* Sacc.	Clyde (Boyd, **5**, i, 114)

GAILLARDIA

Mosaic	Cucumis Virus 1 K. M. Smith	Forth (**26**, xxiii, 56)

GALANTHUS NIVALIS (Snowdrop)

*Bulb Rot	*Penicillium corymbiferum* Westling	Forth (Det. H. H. Bunting)
*Grey Mould	*Botrytis galanthina* (B. & Br.) Sacc.	Tweed, Forth, Tay

GENTIANA MACAULEYI

*Leaf Blight	*Leptothyrium gentianaecolum* Bauml.	Forth, Clyde

GENTIANA SINO-ORNATA

*Leaf and Stem Blight	*Macrophoma* sp.	Solway

GLADIOLUS HYBRIDS

*Scab and Neck Rot	*Bacterium marginatum* McCull.	Tweed, Forth, Tay

This is the commonest disease of gladioli in Scotland and is probably to be found wherever they are cultivated to any extent. Local growers apply the name 'Varnish Pit' to the lesion on the corm, a term which corresponds to the German 'Lack-schorf' and is far more descriptive than 'Scab'.

*Dry Rot	*Sclerotinia Gladioli* Drayt.	Forth, Clyde, Tay
*Hard Rot	*Septoria Gladioli* Passer.	Clyde

A single specimen seen in 1938.

*Core Rot	*Botrytis* sp.	Forth

First recorded in the winter 1938–9 on Dutch corms but subsequently seen in corms of English and Scottish origin and doubtless long established in this country. This fungus does not agree at all points with *Botrytis Gladioli* Kleb., and is best regarded meantime as a strain of *B. cinerea*.

*Storage Rot	*Penicillium Gladioli* McCulloch	Forth, Tay

Only seen in imported corms.

*Leaf Spot	*Heterosporium gracile* Sacc.	Tweed, Forth, Clyde, Tay

GLOXINIA SPECIOSA

*Mosaic	Lycopersicum Virus 3 K. M. Smith	Forth, Clyde
*Wilt	*Phytophthora cryptogea* Pethybr. & Laff.	Forth

GODETIA sp.

*Root Rot	*Phytophthora Cactorum* (Leb. & Cohn) Schroet.	Tay

HELIANTHUS sp.

*Wilt	*Sclerotinia sclerotiorum* (Lib.) de Bary	Dee

HELLEBORUS NIGER (Christmas Rose)

*Leaf Spot	*Coniothyrium Hellebori* Cooke & Massee	Forth

On the fresh specimen the pycnospores are frequently colourless, in which state the fungus agrees with *Phyllosticta atrozonata* Voss. When dried material is re-examined, however, the spores are all found to have turned brown. The disease affects perianth leaves as well as foliage.

HIPPEASTRUM sp.

*Red Ring Spot	Lycopersicum Virus 3 K. M. Smith	Tweed, Forth, Moray

HYACINTHUS ORIENTALIS

*Yellows	*Bacterium Hyacinthi* Wakk.	Forth, Clyde, Tay
*Soft Rot	*Bacterium carotovorum* (L. R. Jones) Lehm.	Forth
*Bulb Rot	*Penicillium corymbiferum* Westling	Forth, Tay (Det. H. H. Bunting)
*Gummosis	Non-pathogenic	Clyde
*Loose-bud	A varietal characteristic recorded in 'Bismarck' and 'L'Innocence'	
*Eelworm injury	*Anguillulina dipsaci* (Kühn) Gerv. & v. Ben.	Forth, Clyde, Tay

As all hyacinth bulbs are imported the distribution of these records has little significance.

HYDRANGEA HORTENSIS

*Mildew	*Microsphaera polonica* Siemaszko (*Oidium* only)	Clyde, Tay
*Mould	*Cladosporium herbarum* (Link) Fr.	Forth

IRIS sp.

*Leaf Spot	*Didymellina macrospora* Kleb.	Solway, Forth
*Rust	*Puccinia Iridis* (DC.) Wallr.	Forth, Clyde
*Ink Disease	*Mystrosporium adustum* Mass.	Moray
*Storage Rot	*Penicillium* sp.	Forth, Clyde

LABURNUM VULGARE

*Branch Canker	*Cucurbitaria Laburni* de Not.	Tweed, Forth, Clyde, Tay, Dee, Moray
Leaf Spot	*Phyllosticta Cytisi* Desm.	Dee (Trail, **1**, N.S. iii, 271)
	Ascochyta Kabatiana Trott.	Clyde (**16**, i, 300)

Grove (**16**, 1, 301) says these are the same fungus.

Mildew	*Oidium* sp.	Dee (Farquharson, **2**, 1911, 242)
Leaf Spot	*Gloeosporium Cytisi* B. & Br.	Tay (Stevenson, **1** vi, 118)

The record of *Calonectria Pseudopeziza* in the previous list cannot be substantiated and should be deleted.

LATHYRUS ODORATUS (Sweet Pea)

*Stripe	Unidentified Virus	Forth, Clyde, Tay, Dee, Moray
Crown Gall	*Bacterium tumefaciens* E.F.Sm. & Towns.	Clyde
*Root Rot	*Aphanomyces euteiches* Drechsl.	Tweed, Solway, Forth, Clyde, Argyll, Tay

LATHYRUS ODORATUS (Sweet Pea) (*continued*)

*Downy Mildew	*Peronospora Viciae* (Berk.) de Bary	Tweed, Forth, Moray
*Foot Rot	*Ascochyta pinodella* L. K. Jones	Clyde
*Leaf Spot	*Ascochyta Pisi* Lib.	Forth, Clyde
*Root Rot	*Thielaviopsis basicola* (Berk.) Ferraris	Forth, Clyde
Pythium spp., *Corticium Solani* and *Fusarium* spp. have also been found associated with root rots.		
*White Mould	*Erostrotheca multiformis* Martin & Charles (*Cladosporium* stage)	Tweed

LAVANDULA (Lavender)

Shab	*Phoma Lavandulae* Gabot	Forth

LIGUSTRUM VULGARE (Privet)

*Root Rot	*Armillaria mellea* (Vahl) Fr.	Clyde, Tay, Moray
Leaf Spot	*Phyllosticta Ligustri* Sacc.	Clyde, Dee (Trail, **1**, N.S. iv, 64 and N.S. iii, 118)

LILIUM spp.

*Virus Diseases. Two virus diseases of lilies are recognized in England, viz. Rosette, caused by Lilium Virus 1 K. M. Smith, and Mosaic, caused by Cucumis Virus 1 K. M. Smith. Scottish records probably refer to the latter, but the diseases have not been studied and differentiated in this country. Probable virus diseases have been recorded in Scotland on *Lilium auratum, L. Brownii, L. candidum, L. centrifolium, L. chalcedonicum, L. formosum, L. melpomene, L. sargentia* and *L. tigrinum.*

*Foot Rot (*L. auratum*)	*Phytophthora Cactorum* (Leb. & Cohn) Schroet.	Clyde
*Root Rot	*Pythium* spp.	Forth
*Crown Rot (*L. auratum*)	*Corticium Solani* Bourd. & Galz.	Forth
*The Lily Disease	*Botrytis elliptica* (Berk.) Cooke	Solway, Forth, Tay, Moray
On *Lilium aurantiacum, L. candidum, L. dauricum, L. Hansonii, L. Martagon, L. pardalinum, L. platyphyllum, L. regale, L. szovitsianum, L. testaceum,* and *L. tigrinum.*		
*Stem Rot (*L. Hansonii*)	*Fusarium* sp. associated	Clyde (Colonsay)

LUPINUS sp.

*Sore Shin	Cucumis Virus 1 K. M. Smith	Forth (Det. K. M. Smith)
*Mildew	*Erysiphe Polygoni* DC.	Forth

MAHONIA AQUIFOLIA

*Rust	*Puccinia mirabilissima* Peck	Tweed, Solway, Forth, Clyde, Tay
First recorded in 1922 (7, xxviii, 164).		
Leaf Spots	*Phyllosticta mahoniana* (Sacc.) Allesch.	Solway (Boyd, **3**, iii, 367), Clyde (Boyd, **5**, iv, 125), Dee (Trail, **1**, N.S. iv, 280)
	Phyllosticta Mahoniae Sacc. & Speg.	Dee (Trail, **1**, N.S. iv, 280)

MATTHIOLA sp. (Stock)

*Breaking of Flower Colour	Probably Brassica Virus 1 K. M. Smith	Forth
*Wilt	*Phytophthora cryptogea* Pethybr. & Laff.	Forth
*Downy Mildew	*Peronospora Matthiolae* Gäum.	Forth, Tay
*Wire Stem and Foot Rot	*Corticium Solani* Bourd. & Galz.	Forth, Clyde, Tay
*Blackleg	*Phoma lingam* (Tode) Desm.	Clyde
*Grey Mould	*Botrytis cinerea* Pers.	Tay

MECONOPSIS spp.

*Smother	*Mucilago spongiosa* (Leyss) Morgan	Tweed
*Root Rot (*M. Wallichi*)	*Phytophthora Cactorum* (Leb. & Cohn) Schroet.	Tay

MECONOPSIS spp. (*continued*)

*Root Rot	*Phytophthora verrucosa* Alcock & Foister	Forth
*Damping Off	*Phytophthora parasitica* Dast.	Forth
*Mildew	*Peronospora arborescens* (Berk.) de Bary	Tweed, Solway, Forth, Clyde, Argyll, Tay, Moray
*Stem Rot and Wilt	*Sclerotinia sclerotiorum* (Lib.) de Bary	Forth

MUSCARI POLYANTHUM

Rust	*Uromyces Scillarum* Wint.	Forth (Wilson, **7**, xxxi, 365)

MYOSOTIS sp. (Forget-me-not)

Downy Mildew	*Peronospora Myosotidis* de Bary	Clyde (Boyd, **6**, N.S. iv, 29), Dee (**1**, N.S. iv, 276)

The published records relate to *Myosotis arvensis*, *M. caespitosa* and *M. versicolor*.

*Mildew	*Erysiphe horridula* (Wallr.) Lév.	Forth, Tay
Leaf Spot	*Entyloma Fergussoni* (B. & Br.) Plowr.	Solway (**4**, 1909), Clyde (Boyd, **7**, N.S. viii, 267; iv, 26), Tay, Dee, Moray (Trail, **1**, N.S. iv, 370)

All published records seem to relate to wild plants of *Myosotis arvensis*, *M. caespitosa* and *M. palustris*.

MYRTUS sp. (Myrtle)

Leaf Spot	*Cercospora Myrti* Erikss.	Clyde (**3**, vi, 157)

NARCISSUS spp.

*Stripe	? Tulipa Virus 1 K. M. Smith	Forth
*Root Rot	*Pythium intermedium* de Bary	Clyde (Det. S. F. Ashby)
*Fire	*Sclerotinia polyblastis* Gregory (*Botrytis* stage)	Forth, Clyde
*Smoulder	*Botrytis narcissicola* Kleb.	Forth, Clyde, Tay
*Leaf Scorch	*Stagonospora Curtisii* (Berk.) Sacc.	Clyde
*White Mould	*Ramularia vallisumbrosae* Cav.	Tweed, Clyde
*Bulb Rot	*Fusarium bulbigenum* Cooke & Massee	Tweed, Clyde, Tay
*Storage Rot	*Penicillium* sp. and *Trichoderma viride* Pers.	Forth

Usually found in damaged bulbs or associated with mites.

*Small Speck	*Sclerotium* sp.	Forth

This organism, the sclerotia of which are commonly found on the dry outer scales of *Narcissus* and *Galanthus* bulbs, closely resembles *Sclerotinia Gladioli*, but its perfect stage has not yet been obtained. In pure cultures on sterilized wheat grains it produces receptive bodies nearly 1 cm. long but so far a strain forming microconidia has not been secured. The fungus is probably not a parasite.

*Eelworm injury	*Anguillulina dipsaci* (Kühn) Gerv. & v. Ben.	Tweed, Forth, Clyde, Tay

NEMESIA sp.

*Root Rot	*Phytophthora parasitica* Dast.	Forth

NYMPHAEA sp. (Water Lily)

Leaf Spot	*Gloeosporium* sp. (probably *G Nymphaearum* Allesch.)	Forth

OXALIS ROSEA AND *O. CORNICULATA*

*Mildew	*Oidium Oxalidis* McAlp.	Forth

PAEONIA sp.

*Leaf Blotch	*Septoria Paeoniae* West. var. *berolinensis* Allesch.	Forth, Clyde
*Wilt	*Botrytis Paeoniae* Oud.	Forth, Tay

PAPAVER SOMNIFERUM (Opium Poppy)

*Mildew	*Peronospora arborescens* (Berk.) de Bary	Tay

Also recorded on *Papaver dubium* in Forth and by Trail in Dee, Tay and Moray (**1**, N.S. iii, 81).

PELARGONIUM ZONALE

*Leaf Curl	Pelargonium Virus 1 K. M. Smith	Forth, Clyde
*Blackleg	*Pythium* sp.	Tweed
*Leaf and Stem Rot	*Botrytis cinerea* Pers.	Forth, Clyde
*Oedema	Non-parasitic	Solway, Forth

PETASITES JAPONICUS AND *P. PALMATUS*

Rust	*Coleosporium Petasitis* Lév.	Tweed (Wilson, **3**, ix, 142)

PETUNIA sp.

*Foot-rot	*Phytophthora cryptogea* Pethybr. & Laff.	Forth

PHILADELPHUS CORONARIUS

Leaf Spot	*Ascochyta Philadelphi* Sacc. & Speg.	Solway (**4**, 1911), Forth (**9**, vi, 273), Clyde (**5**, ii, 95), Tay (**4**, 1910)

PHLOX spp.

*Damping Off	*Phytophthora parasitica* Dast.	Forth
*Stem Rot	*Phoma* ? *Phlogis* Bourn.	Forth
*Leaf Spot	*Septoria divaricatae* Ell. & Ev.	Forth

The specimen in question yielded spores up to $58 \times 1\,\mu$.

*Black Mould	*Cladosporium herbarum* (Link) Fr.	Forth
*Eelworm Disease	*Anguillulina dipsaci* (Kühn) Gerv. & v. Ben.	Tweed, Forth, Clyde, Tay

PHORMIUM TENAX (New Zealand Flax)

*Leaf Spot	*Glomerella phacidiomorpha* (Cesati) Petrak	Solway

POTENTILLA sp. (Gibson's Scarlet)

Crown Gall	*Bacterium tumefaciens* E.F.Sm. & Towns.	Clyde

PRIMULA: Hardy spp.

*Foot Rot and Root Rot (*Primula japonica*)	*Phytophthora Cactorum* (Leb. & Cohn) var. *applanatum* Chester	Tweed
*Foot Rot	*Phytophthora parasitica* Dast.	Moray
*Foot Rot	*Phytophthora* sp. associated with *Thielaviopsis basicola* (Berk.) Ferraris and *Corticium Solani* Bourd. & Galz.	Forth

On *Primula ianthina*, *P. leuchochnoa*, *P. muliensis*, *P. russeola*, *P. sinoplantaginea*, *P. sinopurpurea*, *P. sonchifolia*, and *P. szechuanica*.

*Also *P. verrucosa* Alcock & Foister on *Primula* seedlings		Forth
Downy Mildew (*Primula vulgaris*) Recorded as *Peronospora candida* Fuckel	*Peronospora Oerteliana* Kühn	Forth, Tay, Dee, Moray, Ross (**13**, 278), Clyde (Boyd, **5**, iv, 124)
Ovary Smut	*Tuburcinia primulicola* (Magn.) Bref.	Dee (Trail, **1**, N.S. iv, 370)
*Rust	*Puccinia Primulae* Duby	Tweed, Solway, Forth, Clyde, Argyll, Tay, Moray, Ross
*Leaf Spot	*Cercosporella Primulae* Allesch.	Tweed
*Leaf Spot	*Ovularia primulana* Karst.	Tweed, Forth, Clyde, Argyll, Tay, Dee
*Leaf Spot	*Ascochyta Primulae* Trail	Tay, Dee
*Leaf Spot	*Phyllosticta primulicola* Desm.	Forth
*Eelworm Injury	*Anguillulina dipsaci* (Kühn) Gerv. & v. Ben.	Forth, Clyde, Dee, Moray

PRIMULA: Glasshouse species		
*'Mosaic'	Perhaps Cucumis Virus 1 or Lycopersicum Virus 3 K. M. Smith	Clyde
*Crown Rot (*P. obconica*)	*Phytophthora Cactorum* (Leb. & Cohn) Schroet.	Tay
*Damping Off (*P. malacoides*)	*Phytophthora* sp.	Clyde
PRUNUS AMYGDALUS (Almond)		
*Leaf Curl	*Taphrina deformans* (Berk.) Tul.	Forth, Clyde, Tay
PRUNUS BESSEYI (American Sand Cherry)		
*Wither Tip	*Sclerotinia laxa* Aderh. & Ruhl.	Clyde
PRUNUS INCISA		
*Die Back	*Sphaeropsis Malorum* Berk.	Tay
PRUNUS LAUROCERASUS (Cherry Laurel)		
*Leaf Spot	*Trochila Laurocerasi* (Desm.) Fr.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross
PYRACANTHUS COCCINEA var. *LAELANDEI*		
*Scab	*Fusicladium pirinum* (Lib.) Fuckel var. *Pyracanthae* Thüm.	Clyde, Tay
PYRETHRUM ROSEUM		
*Root Rot	*Corticium Solani* Bourd. & Galz.	Forth
RESEDA ODORATA (Mignonette)		
*Foot Rot	*Corticium Solani* Bourd. & Galz.	Forth
RHUS sp. (Sumach)		
*Leaf Spot	*Phyllosticta* sp.	Tweed
RHODODENDRON spp.		
*Leaf Blight and Canker	*Lophodermium melaleucum* Fr.	Tweed
*Twig Blight	*Lembosia* sp.	Clyde
*Gall (on *R. ferrugineum*)	*Exobasidium Vaccinii* (Fuckel) Woron.	Solway, Forth, Clyde, Tay, Dee
Rust (on *R. hirsutum*)	*Chrysomyxa Rhododendri* de Bary	Clyde (**5**, v, 126)
*Root Rot	*Armillaria mellea* (Vahl) Fr.	Forth, Moray
*Leaf Scorch	*Sporocybe Azaleae* (Peck) Sacc.	Forth, Clyde, Tay, Dee, Moray
*Leaf Spots	*Phyllosticta Rhododendri* Westend.	Forth, Tay
	Phoma Rhodorae Cooke	Clyde (**16**, i, 100)
	Macrophoma cylindrospora Berl. & Vogl.	Clyde
	Diplodia Rhododendri Westend.	Dee (Trail, **1**, N.S. iii, 45)
Some of these are probably saprophytes living on leaf lesions due to other causes.		
*Stem Canker	*Botrytis cinerea* Pers.	Argyll
RICHARDIA AFRICANA (Arum Lily)		
*Ring Spot	Lycopersicum Virus 3 K. M. Smith	Forth, Clyde, Tay, Moray
Leaf Spot	*Phyllosticta Richardiae* Halsted	Tay (Macdonald, **7**, xxxii, 556)
ROMNEYA COULTHERI		
*Foot Rot	*Phytophthora* sp.	Clyde
ROSA spp.		
*Root Rot	*Phytophthora* sp.	Forth
*Mildew	*Sphaerotheca pannosa* (Wallr.) Lév.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross

ROSA spp. (*continued*)

*Black Spot	*Diplocarpon Rosae* Wolf (*Actinonema* stage only)	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross
*Stem Canker	*Leptosphaeria Coniothyrium* (Fuckel) Sacc. (*Coniothyrium* stage only)	Solway, Forth, Tay
*Canker	'*Botryosphaeria* sp.'	Clyde (a single specimen in 1934)

Probably this fungus was *Griphosphaeria corticola* (Fuckel) v. Höhnel, which Brooks and el Alaily have shown to be the perfect stage of the rose form of *Coryneum microstictum* B. & Br. As no specimens were kept the matter cannot now be decided. Die Back associated with *Coryneum microstictum* has been recorded from Forth, Clyde, Tay and Dee.

*Rust	*Phragmidium mucronatum* (Pers.) Schlecht.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross, Orkney

Most published records relate to *Rosa canina* and *R. tomentosa*, but the fungus is common on cultivated roses.

Leaf Spot	*Sphaceloma Rosarum* (Passer.) Jenk.	Forth, Moray
Leaf Spot	*Septoria Rosae* Desm.	Clyde (Trail, **1**, N.S. iv, 65), Tay, Dee (**1**, N.S. iii, 224), Moray (**4**, 1912)

Probably only on wild roses (*Rosa canina* and *R. tomentosa*).

*Grey Mould	*Botrytis cinerea* Pers.	Tweed, Forth, Tay
*Die Back	*Cryptosporium minimum* Laub.	Tay

Recorded on a rambler rose, the primary injury to which was probably due to frost.

SAXIFRAGA spp. (Cultivated Saxifrages)

Rust	*Puccinia Pazschkei* Dietel (on *Saxifraga aizoon* var. *cultrata*, *S. cotyledon* var. *Caterhamensis*, *S. Hostii* and var. *rhaetica*, and *S. longifolia*)	Forth, Clyde (Wilson, **7**, xxxi, 383–4), Tay (Macdonald, **7**, xxxii, 556)

SCHIZANTHUS sp.

*Wilt	*Phytophthora cryptogea* Pethybr. & Laff.	Forth
*Root Rot	*Pythium* sp.	Clyde
*Mildew	*Erysiphe Cichoracearum* DC.	Forth
*Eelworm Injury	*Anguillulina dipsaci* (Kühn) Gerv. & v. Ben.	Clyde

SCILLA spp.

*Smut (*S. verna*)	*Ustilago Vaillantii* Tul.	Clyde, Forth
*Rust (*S. nutans*)	*Uromyces Scillarum* Wint.	Tweed, Solway, Forth, Clyde, Tay, Moray
Leaf Spot (*S. nutans*)	*Septoria Scillae* Westend.	Clyde (**3**, vi, 49)
Bulb Rot	*Penicillium cyclopium* Westling	Tay (recorded by Macfarlane on bulbs imported from Holland, **7**, xxxii, 542)

SENECIO SMITHII

Rust	*Coleosporium Senecionis* Fr.	Argyll (Wilson, **3**, ix, 141)

STRANSVAESIA DAVIDIANA

*Root Rot	*Armillaria mellea* (Vahl) Fr.	Clyde

SYRINGA VULGARIS (Lilac)

*'Mosaic'		Forth

A single case in 1936. Possibly this was the Leaf Curl Virus disease described by K. M. Smith (**18**, cvii, 144).

*Wilt	*Phytophthora Syringae* Kleb.	Forth, Dee

Recorded by Berkeley as *Ovularia Syringae* n.sp. from Dee in 1881 (**18**, xvi, 665).

Leaf Spot	*Phyllosticta Syringae* Westend.	Clyde (Boyd, **5**, ii, 95), Dee (Trail, **1**, N.S. iv, 280)
*Grey Mould	*Botrytis cinerea* Pers.	Clyde

Keith (**1**, ii, 247) records *Polyporus radiatus* (Sow.) Fr. on this host in Moray.

TROPAEOLUM MAJUS (Nasturtium)

*Leaf Spot	Unidentified bacterium	Clyde

TULIPA sp.

*Breaking	Tulipa Virus 1 K. M. Smith	Forth
*Shanking	*Phytophthora cryptogea* Pethybr. & Laff.	Forth, Clyde
	Phytophthora erythroseptica Pethybr.	Clyde
*Rust	*Puccinia Prostii* Moug.	Forth

Occurs only on *Tulipa sylvestris* at the Royal Botanic Garden, Edinburgh.

*Fire	*Botrytis Tulipae* (Lib.) Lind.	Forth, Clyde, Tay, Dee, Moray
*Grey Bulb Rot	*Sclerotium Tuliparum* Kleb.	Forth, Clyde, Tay
*Bulb Rot	*Fusarium* sp. associated	Forth
*Chalking	*Penicillium* sp. associated (see Moore, 30, cxvii, 40–41)	Forth, Tay
*Hard Base	Non-parasitic	Tay
*Blindness	Non-parasitic	Forth, Moray

Commonly attributed to heating in transit or in storage.

TURF (Various Grasses)

*Red Leaf and Root	*Cladochytrium caespitis* Griffon & Maublanc (Det. G. H. Pethybridge)	Forth, Tay
*Smother	*Mucilago spongiosa* (Leyss) Morgan	Forth, Clyde
*Brown Patch	*Calonectria graminicola* (B. & Br.) Wollenw. (*Fusarium* stage only)	Forth, Clyde, Moray
*Brown Patch	*Sclerotinia homoeocarpa* Bennett (*Rhizoctonia* stage only)	Forth, Clyde
*Scorch	*Corticium fuciforme* (Berk.) Wakef. (*Isaria* stage only)	Solway, Forth, Clyde, Tay
*Fairy Ring	*Lycoperdon* sp.	Forth, Clyde

VERONICA (Shrubby spp.)

*Root Rot (*V. propinqua*)	*Armillaria mellea* (Vahl) Fr.	Forth

Shrubby species of *Veronica* suffered severely from the hard frosts of January and February 1940, and often all but the main stem of the plant was killed.

VIOLA spp. (including Pansy, Violet)

*Root Rot	*Aphanomyces euteiches* Dreschsl.	Tweed, Forth, Clyde, Tay, Dee
*Root Rot	*Phytophthora Cactorum* (Lib. & Cohn) Schroet.	Forth
Downy Mildew (*V. tricolor* and *V. arvensis*)	*Peronospora Violae* de Bary	Clyde (Boyd, **6**, N.S. v, 162), Dee, (Trail, **1**, N.S. iii, 356), Orkney (Trail, **1**, N.S. iv, 31)
*Rust	*Puccinia Violae* (Schum.) DC.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross, Sutherland, Orkney

Almost all published records are on wild violets (*Viola canina*, *V. hirta*, *V. sylvatica* and *V. Riviniana*) but Wilson, **7**, xxxi, 382 has it on *V. odorata*.

*Rust (*V. tricolor*, *V. lutea* var. *amoena* and *V. Curtisii* var. *Fosteri*	*Puccinia depauperans* Sydow	Solway, Forth, Clyde, Tay, Moray
*Foot Rot	*Corticium Solani* Bourd. & Galz.	Forth, Tay
*Mildew	*Oidium* sp.	Forth, Clyde

VIOLA spp. (*continued*)

*Leaf Spots (*V. odorata*)	*Phyllosticta Violae* Desm.	Argyll (White, **1**, vi, 161), Tay (**1**, v, 276), Dee (Stevenson, **1**, N.S. i, 181)

A species of *Phoma* having spores about $9 \times 2\mu$, apparently not *Darluca filum* (see Grove, **16**, i, 113), has occurred on cultivated Violas in Forth and Tay.

*(*V. odorata*)	*Alternaria* sp.	Clyde
*(*V. sylvatica* and *V. Riviniana*)	*Ramularia Violae* Trail	Solway (**4**, 1909), Clyde, Argyll (Trail, **1**, N.S. iv, 67), Tay (**1**, N.S. iv, 275), Dee (Trail, **1**, N.S. iv, 74), Moray (**4**, 1912)
*Cultivated hybrids	*Ramularia lactea* Desm.	Solway, Clyde, Moray
*Cultivated hybrids	*Ramularia deflectens* Bres.	Clyde
(*V. tricolor*)	*Ramularia agrestis* Sacc.	Dee (Trail, **1**, N.S. iii, 41)
(*V. odorata*)	*Gloeosporium Violae* B. & Br.	Forth (Trail, **1**, N.S. iii, 267) (probably=*P. Violae* above, see Grove, **16**, ii, 229)
*(*V. odorata*)	*Ascochyta Violae* Sacc. & Speg.	Solway, Forth
(*V. sylvatica*)	*Septoria Violae* Westend.	Clyde (**4**, 1928), Tay (White, **1**, v, 92), Dee (Stevenson & Trail, **1**, N.S. ii, 187), Moray (**4**, 1927)
*(*V. sylvatica* and *V. Riviniana*)	*Urocystis Violae* (Sow.) Fisch. de Waldh.	Tweed, Dee, Moray

There appears to be some confusion in the nomenclature of leaf-spot fungi on *Viola* spp., and it has seemed best to include all the species recorded, whether on cultivated plants or not, as their host ranges are uncertain. Species on *V. palustris* only are omitted.

ZINNIA sp.

*Foot Rot	*Phytophthora cryptogea* Pethybr.	Forth
*Grey Mould	*Botrytis cinerea* Pers.	Tweed, Forth

TREES

ABIES NOBILIS (Noble Fir)

Root Rot	*Armillaria mellea* (Vahl) Fr.	Dee (Ritchie, **14**, xlvi, 132)
Defoliation	*Rhizosphaera Kalkhoffii* Bubák	Loc.? (Wilson & Waldie, **17**, xl, 34)

Dasyscypha resinaria Rehm is reported on *Abies nobilis* from Tay (**4**, 1930).

ABIES NORMANNIANA (Caucasian Fir)

Witches' Broom	*Melampsorella Caryophyllacearum* Schroet.	Tay (Wilson, **3**, ix, 140)

ABIES PECTINATA (European Silver Fir)

Scorch	*Acanthostigma parasiticum* Sacc.	Clyde (H. Watson, **14**, xlvii, 71)
Die Back	*Rehmelliopsis bohemica* Bub. & Kab.	Clyde, Moray
Rust	*Aecidium pseudocolumnare* Kühn	Tweed, Moray (Wilson, **7**, xxxi, 433)

In Scotland this appears to be the aecidial stage of *Milesina Kriegeriana* P. Magn.

Witches' Broom	*Melampsorella Caryophyllacearum* Schroet.	Solway (**4**, 1924 and 1911), Clyde (**6** N.S. viii, 110)
? Canker	*Aleurodiscus amorphus* (Pers.) Rabenh.	Solway (**4**, 1924)

This fungus has also been reported from Tay (**1**, iii, 270 and **1**, v, 273) and Dee (**1**, N.S. iii, 168) in dead spruce branches lying on the ground and on dead silver fir.

Defoliation	*Rhizosphaera Kalkhoffii* Bubák	(Wilson & Waldie, **17**, xl, 34)

ACER PSEUDOPLATANUS (Sycamore)

*Mildew	*Uncinula Aceris* (DC.) Sacc.	Solway, Forth, Clyde, Tay, Dee, Moray
*Tar Spot	*Rhytisma acerinum* (Pers.) Fr.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross

The form *Rhytisma punctatum* (Pers.) Fr. is on record from Solway, Clyde, Tay, Dee.

*Root Rot	*Armillaria mellea* (Vahl) Fr.	Forth

ACER PSEUDOPLATANUS (Sycamore) (*continued*)

*Heart Rot	*Polyporus squamosus* (Huds.) Fr.	Forth, Clyde
Leaf Spot	*Phleospora Aceris* Sacc.	Forth (Boyd, **9**, vi, 343), Clyde (Boyd, **5**, i, 52), Tay (Trail, **1**, N.S. iii, 232), Moray (**4**, 1912)

Also on *Acer campestre* in Dee (Trail, **1**, N.S. iv, 281).

Leaf Blotch	*Cristulariella depraedens* (Cooke) v. Höhn.	Forth (**9**, vi, 273), Clyde (Boyd, **5**, iv, 16), Tay (**4**, 1910)
*Slime Flux	*Oospora* sp., associated	Forth

The record of *Gnomonia veneta* in the previous list cannot be substantiated and should be deleted.

ALNUS GLUTINOSA (Alder)

Mildew	*Phyllactinia corylea* (Pers.) Karst.	? Dee (Trail, **6**, N.S. iii, 12)
*Leaf Curl	*Taphrina Tosquinetii* (Westend.) Magn.	Forth, Clyde, Argyll, Tay, Dee, Moray
*Leaf Spot	*Taphrina Sadebeckii* Johans.	Forth, Clyde, Argyll, Dee (Trail, **1**, N.S. iv, 61 and 278)

Trail (1, N.S. iv, 277) also has '*Exoascus Alni* B. & Br. on female catkins of *Alnus glutinosa*' in Dee and Orkney.

*Coral Spot	*Nectria cinnabarina* (Tode) Fr.	Tay
*Die Back and Heart Rot	*Polyporus radiatus* (Sow.) Fr.	Tweed, Solway, Clyde, Tay, Moray
Rust	*Melampsoridium Alni* Diet.	Clyde, Tay, Dee (Wilson, **7**, xxxi, 425)
*Leaf Spot	*Leptothyrium alneum* Sacc.	Forth, Clyde, Argyll, Tay, Dee, Moray
*Root nodules	*Schinzia Alni* Woron.	Clyde, Tay, Dee, Moray

These doubtless occur wherever alders are found.

BETULA ALBA (Birch)

Mildew	*Phyllactinia corylea* (Pers.) Karst.	Forth (Boyd, **9**, vii, 187), Clyde (**5**, vii, 13), Moray (Keith, **1**, v, 9), Orkney (Trail, **6**, N.S. iii, 12)
*Witches' Broom	*Taphrina turgidus* (Fuckel) Sadeb.	Tweed, Solway, Forth, Clyde, Argyll, Dee, Moray
*White Heart Rot	*Fomes fomentarius* (L.) Fr.	Tweed, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross
Heart Rot	*Fomes annosus* Fr.	Clyde, Dee (**4**, 1932 and 1931)
*Brown Cubical Rot	*Polyporus betulinus* (Bull.) Fr.	Tweed, Solway, Forth, Clyde, Tay, Dee, Argyll, Moray, Ross
*Rust	*Melampsoridium betulinum* Kleb.	Tweed, Solway, Forth, Clyde, Argyll, Tay, Dee, Moray, Ross, Sutherland

CASTANEA VESCA (Spanish Chestnut)

*Leaf Spot	*Septoria castaneicola* Desm.	Clyde, Moray

Fistulina hepatica (Huds.) Fr. has been recorded on this host in Forth (**9**, iii, 45) and Tay (**10**, vi, Proceedings, 144).

CEDRUS spp. (Cedars)

Canker	*Phomopsis Pseudotsugae* Wilson	Loc.? (Wilson, **18**, lxxxviii, 412)

CORYLUS AVELLANA (Hazel)

Mildew	*Phyllactinia corylea* (Pers.) Karst.	Tay (**4**, 1906)
Leaf Spot	*Gnomoniella Coryli* (Batsch) Sacc.	Argyll (White, **1**, vi, 162), Moray (Keith, **1**, v, 15)
Leaf Spot	*Labrella Coryli* (Rabenh.) Sacc.	Clyde (Boyd, **5**, viii, 56)
Leaf Spot	*Septoria Avellanae* B. & Br.	Clyde (Trail, **1**, N.S. iv, 65)

CRATAEGUS spp. (Hawthorn)

*Mildew	*Podosphaera Oxyacanthae* (DC.) de Bary	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Argyll
*Rust	*Gymnosporangium clavariaeforme* (Jacq.) DC.	Tweed, Solway, Forth, Tay, Dee, Moray
*Leaf Blotch	*Sclerotinia Crataegi* Magn.	Clyde (Fide A. Smith)
Leaf Curl	*Taphrina bullata* (Berk.) Tul.	Dee (Trail, **1**, N.S. iii, 172)
Leaf Spot	*Phleospora Oxyacanthae* (Kunze & Schmidt) Wallr.	Solway (**4**, 1909), Tay (**13**, 216)

*Witches' Brooms of unknown origin have been observed on Hawthorn in Tweed and Tay. They were first recorded in 'West Fife' by Robertson (**7**, xxi, 313, 1900), who noted similar structures on ash, larch and *Abies nobilis*.

FAGUS SYLVATICUS (Beech)

*Heart Rot	*Fomes fomentarius* (L.) Fr.	Solway, Clyde
*Root Rot	*Armillaria mellea* (Vahl) Fr.	Forth, Clyde

FRAXINUS EXCELSIOR (Ash)

*Canker	Probably *Bacterium Savastanoi* E. F. Sm. var. *Fraxini* N. A. Brown	Tweed, Solway, Forth, Clyde, Argyll

The common ash canker is assumed to be due to the above organism, but *Nectria galligena* Bres. is on record from ash in Clyde (**4**, 1932).

*White Rot	*Polyporus hispidus* (Bull.) Fr.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray

Ganoderma applanatum (Pers.) Pat. common on dead wood, was recorded 'on a living ash tree' from Moray (Keith, **1**, ii, 247). *Fomes fraxineus* (Bull.) Fr. is on record on old ash from Tay and Dee (**13**, 138) and *Polyporus squamosus* (Huds.) Fr. on ash trunks from Moray (**1**, ii, 247).

*Brown Rot	*Pholiota adiposa* Fr.	Forth, Clyde
Canker	*Phomopsis scobina* (Cooke) v. Höhn.	Tweed, Solway, Forth, Tay, Moray
Die Back	*Phomopsis controversa* (Sacc.) Trav.	(Macdonald & Russell, **7**, xxxii, 341)

JUNIPERUS COMMUNIS (Juniper)

Leaf Spot	*Keithia tetraspora* (Phil. & Keith) Sacc.	Tay (Menzies, **10**, vii, 27), Moray (Phillips & Keith, **18**, xiv, 308)
*Rust	*Gymnosporangium clavariaeforme* (Jacq.) DC.	Tweed, Solway, Forth, Tay, Dee, Moray
	Gymnosporangium Juniperi Link	Solway, Dee, Moray (Trail, **1**, N.S. iv, 321)
*Damping Off	*Corticium Solani* Bourd. & Galz.	Forth

LARIX EUROPAEA (Larch)

*Canker	*Dasyscypha Wilkommii* (Hart.) Rehm	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Argyll
*Leaf Cast	*Meria Laricis* Vuill.	Solway
Rust	*Caeoma Laricis* Plowr.	Clyde (Boyd, **5**, viii, 188), Dee (Trail, **1**, N.S. iii, 356), Moray (Keith, **1**, N.S. i, 271), Tay (**4**, 1925)

This is the collective name for the aecidial stage of a number of species of *Melampsora*. For the other stages see poplars and willows.

Rust	*Peridermium Laricis* (Kleb.) Arth.	Tay, Moray (Borthwick & Wilson **17**, xxvii, 198)
Heart Rot	*Fomes annosus* Fr.	'Fifeshire' (M'Hardy, **14**, xliii, 18), Moray (Keith, **1**, ii, 247)

LARIX LEPTOLEPIS (Japanese Larch)

Canker	*Dasyscypha Wilkommii* (Hart.) Rehm	Solway (Murray, **12**, xvii, 386), Forth (Borthwick, **28**, v, 23), Tay (Pitcaithley, **10**, iii, 37)

Also on *Larix occidentalis* (Borthwick, **28**, v, 23) in Tay.

Rust	*Caeoma Laricis* Plowr.	Clyde (Wilson, **7**, xxxi, 422)
Canker	*Phomopsis Pseudotsugae* Wilson	Tweed (Wilson, **17**, xxxv, 73)
Grey Mould	*Botrytis Douglasii* Tub.	Forth (Wilson, **3**, vii, 85)

LIRIODENDRON TULIPIFERA (Tulip Tree)

*Root Rot	*Armillaria mellea* (Vahl) Fr.	Clyde

PICEA EXCELSA (Spruce)

Bud Blight	*Cucurbitaria Piceae* Borthwick	Moray (Watson, **14**, xxxi, 72)
Leaf Scorch	*Lophodermellina macrospora* (Hartig) Tehon	Moray (Watson, **14**, xxxl, 72)
Seedling Blight	*Rosellinia* cf. *aquila* (Fr.) de Not.	Loc.? (Wilson, **17**, xxxvi, 226)
Canker	*Dasyscypha calyciformis* (Willd.) Rehm	Tweed, Forth (Wilson, **3**, vii, 79)
*Rust	*Chrysomyxa Abietis* Unger	Tweed, Solway, Clyde, Argyll, Tay, Dee, Moray

First recorded in 1911.

*Rust	*Chrysomyxa Rhododendri* de Bary	Solway, Clyde, Dee
Rust	*Thecopsora areolata* Magn.	Forth, Solway (Wilson, **7**, xxxi, 429), Tweed, Clyde, Tay, Argyll, Moray (Trail, **1**, N.S. iv, 327), Dee (Borthwick, **7**, xxiii, 113)
*Root Rot	*Armillaria mellea* (Vahl) Fr.	Forth
Heart Rot	*Fomes annosus* Fr.	Moray (Watson, **14**, xxxi, 72)
Defoliation	*Rhizosphaera Kalkhoffii* Bubák	Loc.? (Wilson & Waldie, **17**, xl, 34)

PICEA PUNGENS (Blue Spruce)

Bud Blight	*Cucurbitaria Piceae* Borthwick	Tay (Borthwick, **28**, iv, 259)
*Defoliation	*Rhizosphaera Kalkhoffii* Bubák	Forth, Clyde

First recorded on *Picea p. argentea* in 1922; also on *P. nigra*, *P. alba*, *P. orientalis* and *P. Schrenkiana* (Wilson & Waldie, **17**, xl, 34).

PICEA SITCHENSIS (Sitka Spruce)

Bud Blight	*Cucurbitaria Piceae* Borthwick	Clyde (**4**, 1932)
Rust	*Chrysomyxa Abietis* Unger	Tweed (Wilson, **7**, xxxi, 411)
*Smother	*Phylacteria terrestris* (Ehrh.) Big. & Guill.	Moray (Det. Miss E. M. Wakefield)
Brown Rot	*Polyporus Schweinitzii* Fr.	Tay (Murray, **17**, xxx, 56)
Root Rot	*Helicobasidium purpureum* (Tul.) Pat.	Moray (Watson, **14**, xl, 58)
Defoliation	*Rhizosphaera Kalkhoffii* Bubák	Clyde (Wilson & Waldie, **17**, xl, 34)

PINUS AUSTRIACA (Austrian Pine)

Rust	*Coleosporium* sp.	Moray (Keith, **1**, N.S. i, 271)
Defoliation	*Rhizosphaera Kalkhoffii* Bubák	Loc.? (Wilson & Waldie, **17**, xl, 34)

Also on *Pinus montana*.

An interesting case of fasciation in *Pinus austriaca* is recorded by Forgan in **2**, 1892, 203.

Die Back	*Brunchorstia destruens* Erikss.	Tweed, Solway, Clyde, Tay, Dee, Moray (Waldie, **17**, l, 120)

Also recorded on *Pinus Cembra*, *P. Laricio* and *P. montana*.

PINUS MONTICOLA (Western White Pine)

*Leaf Cast	*Lophodermium Pinastri* (Schr.) Chev.	Tweed
*Rust	*Cronartium ribicola* Fisch. de Waldh.	Tweed, Solway, Tay

PINUS STROBUS (White Pine)

Canker	*Dasyscypha subtilissima* Cooke	Dee (Farquharson, **2**, 1911, 242)
Leaf Cast	*Hypoderma Desmazierii* Duby	Tay (Wilson, **3**, vii, 81), Dee (Farquharson, **2**, 1911, 242), Clyde (**4**, 1932)

This fungus has been recorded as *Hypoderma brachysporum* (Rostr.) Tubeuf and *H. strobicola* Tubeuf.

Rust	*Cronartium ribicola* Fisch. de Waldh.	Solway (Boyd, **5**, iv, 87)

This rust is also known on *Pinus Cembra*, *P. Lambertiana* in Tay (Wilson, **3**, vii, 83), *P. Ayacahuite*, *P. parviflora* in Solway (at Culzean Castle, **4**, 1926), *P. excelsa* and *P. flexilis* (Wilson, **7**, xxxi, 412).

PINUS SYLVESTRIS (Scotch Pine)

*Leaf Cast	*Lophodermium Pinastri* (Schr.) Chev.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Argyll, Ross
Leaf Cast	*Hypoderma pinicola* Brunch.	Argyll (Wilson, **3**, vii, 79)
Blue Stain	*Ceratostomella Pini* Münch and *C. Piceae* Münch	Tweed, Forth, Dee, Moray (MacCallum, **3**, vii, 232)
Canker	*Dasyscypha subtilissima* Cooke	Solway (**4**, 1924), Forth, Clyde, Tay (Borthwick & Wilson, **17**, xxix, 184)
Rust	*Peridermium Pini* Chev.	Tweed, Forth, Tay, Moray (**13**, 256), Dee (Stevenson, **1**, vi, 31)
Rust	*Coleosporium* spp.	Tay (White, **1**, v, 323), Dee (Stevenson, **1**, vi, 31), Moray (Keith, **1**, N.S. i, 271)
*Root Rot	*Armillaria mellea* (Vahl) Fr.	Solway, Forth, Clyde, Tay, Dee
Red Rot	*Fomes annosus* Fr.	Tweed (Wilson, **3**, xiii, 81), Moray (Boyd, **5**, i, 33), Tay (McIntosh, **10**, iv, Proceedings, 182)
Brown Rot	*Polyporus Schweinitzii* Fr.	Forth (Stevenson, **1**, v, 23), Clyde, Tay, Moray (Stevenson, **13**, 130)

**Sparassis crispa* (Wulf) Fr. is possibly parasitic on Scotch pine in Tweed, Forth, Tay and Moray.

Trametes Pini (Brot.) Fr. has been recorded 'on living trees of *P. sylvestris*' from Moray (**6** N.S. iii, Proceedings, 60).

Die Back	*Brunchorstia destruens* Erikss.	Moray (van Vloten, **14**, xliii, 157)

McIntosh's record (**10**, iv, Proceedings, 182) of *Cucurbitaria pithyophila* Fr. killing 'fir' at Inver (Tay) presumably applies to this host.

Borthwick (**7**, xxi, 196) recorded a witches' broom on *Pinus sylvestris*, locality unspecified.

POPULUS spp. (Poplars)

*Leaf Curl (*P. nigra* and *P. balsamifera*)	*Taphrina aurea* (Pers.) Fr.	Forth, Tay, Dee, Moray
*Carpel Deformation (*P. tremula*)	*Taphrina Johansonii* Sadeb.	Tweed, Forth
Rusts (*P. trichocarpus*)	*Melampsora Allii-populina* Kleb.	Solway (Wilson, **7**, xxxi, 422)
	**Melampsora Larici-populina* Kleb.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray (Wilson, **7**, xxxi, 422)

On *Populus candicans*, *P. generosa*, *P. laurifolia*, *P. nigra*, *P. robusta* and *P. trichocarpa*.

Melampsora Rostrupii Wagner	Forth (Wilson, **7**, xxxi, 423)
Melampsora Larici-tremulae Kleb.	Forth, Clyde, Argyll, Tay, Dee, Moray (Wilson, **7**, xxxi, 422)

On *Populus alba* and *P. tremula*.

*Die Back	*Polyporus squamosus* (Huds.) Fr.	Forth
*Canker and Die Back	*Cytospora chrysosperma* (Pers.) Fr.	Forth, Clyde
*Leaf Spot	*Marssonina Populi* Magn.	Tweed, Forth, Clyde, Tay

Fomes igniarius (L.) Fr. was recorded 'on poplar trees, banks of Findhorn', Moray by Keith (**1**, ii, 247). *Fomes populinus* Fr. has occurred in Tweed (**11**, xxix, 311) and Clyde (**5**, viii, 171).

PSEUDOTSUGA DOUGLASI (Douglas Fir)

*Leaf Cast	*Rhabdocline Pseudotsugae* Syd.	Tweed
Heart Rot	*Fomes annosus* Fr.	'Fifeshire' (M'Hardy, **14**, xliii, 18)
Brown Rot	*Polyporus Schweinitzii* Fr.	Tay (Murray, **17**, xxx, 56)
*Canker	*Phomopsis Pseudotsugae* Wilson	Tweed, Solway, Clyde, Argyll, Tay Dee, Moray

First recorded in 1896 from Clyde as '*Phoma pithya* Sacc.' by Somerville (**17**, xv, 190).

Grey Mould	*Botrytis Douglasii* Tub.	Tay (Wilson, **3**, vii, 85), Dee (Farquharson, **2**, 1911, 240)
Defoliation	*Rhizosphaera Kalkhoffii* Bubák	Loc.? (Wilson & Waldie, **17**, xl, 34)

PYRUS AUCUPARIA (Rowan)

Rust	*Gymnosporangium Juniperi* Link	Tweed, Solway, Forth, Clyde, Tay, Argyll, Dee, Moray, Ross (Trail, **1**, N.S. iv, 321)
Leaf Spots	*Phyllosticta Sorbi* Westend. *Septoria Sorbi* Lasch.	Dee (Trail, **1**, N.S. iv, 280) Tay (White, **1**, v, 276), Dee, Ross (Trail, **1**, N.S. iii, 121)

QUERCUS ROBUR (Oak)

*Mildew	*Microsphaera quercina* (Schw.) Burr.	Solway, Forth, Clyde, Tay, Moray
Leaf Spot	*Taphrina coerulescens* (Dur. & Mont.) Tul.	Tay, Dee (Trail, **10**, ii, 127)
*Leaf Spot	*Sclerotinia Candolleana* (Lév.) Fuckel	Clyde, Tay, Dee, Moray
*Heart Rot	*Polyporus sulphureus* (Bull.) Fr.	Forth, Clyde, Tay
*Brown Oak	*Fistulina hepatica* (Huds.) Fr.	Tweed, Solway, Forth, Clyde, Tay, Moray, Argyll
*Root Rot	*Armillaria mellea* (Vahl) Fr.	Clyde

Polyporus dryadeus (Pers.) Fr. was recorded on living oak in Cadzow Forest, Clyde, by Stevenson (**1**, vi, 37) and from Solway (**1**, N.S. i, 182).

*Canker	*Phomopsis* sp.	Tay
*Brown Slime Flux	Cause unknown	Tay

ROBINIA PSEUDACACIA

Mildew	*Erysiphe Polygoni* DC.	Dee (Farquharson, **2**, 1911, 242)

SALIX spp. (Willows)

Mildew	*Uncinula Salicis* (DC.) Winter	Forth, Moray (Trail, **6**, N.S. iii, 15)
*Black Spot	*Rhytisma salicinum* Pers.	Solway, Clyde, Tay, Dee, Moray, Argyll
*Black Canker	*Physalospora Miyabeana* Fukushi	Forth
*Stem Blister	*Cryptomyces maximus* (Fr.) Rehm.	Moray
*Branch Disease	*Scleroderris fuliginosa* (Pers.) Karst.	Moray

Myxosporium scutellatum (Otth) Petrak, associated.

*Rusts	*Melampsora* spp.	

Eleven species are recognized by Wilson (**7**, xxxi, 416), whose work should be consulted for details of distribution.

*White Heart Rot	*Fomes igniarius* (L.) Fr.	Tweed
*Scab and Die Back	*Fusicladium saliciperdum* (All. & Tub.) Tub.	Clyde
Leaf Spot	*Gloeosporium Salicis* Westend.	Solway (**4**, 1909), Forth (**7**, vi, 196, and 273), Clyde (**5**, i, 115 and 140), Moray (**4**, 1912)
Leaf Spot	*Septogloeum salicinum* Sacc.	Clyde (Boyd, **5**, i, 115)

SEQUOIA GIGANTEA

Cubical Rot	*Coniophora puteana* (Schum.) Karst.	Tay (Macdonald, **24**, xxvi, 83)

TAXUS BACCATA (Yew)

*Leaf Scorch	*Sphaerulina Taxi* Mass.	Tweed, Forth, Clyde, Tay, Dee
*Leaf Scorch	*Physalospora gregaria* Sacc. var. *foliorum* Sacc.	Forth, Clyde
*Canker	*Physalospora* sp.	Tay

Anthostomella Taxi Grove, associated with dying yew in Forth and Clyde is not regarded as a parasite (Callen, **3**, xxii, 94).

Ganoderma lucidum (Leyss.) Karst., which is extremely rare in Scotland, has been recorded on old yews on Inch Lonaig, Loch Lomond, Clyde (**5**, i, 138).

THUJA spp.

*Leaf Spot	*Keithia thujina* Durand	Solway, Clyde, Argyll

An unidentified species of *Pestalotia* is said by Laing (**14**, xliii, 48) to be parasitic on *Thuja*.

TSUGA ALBERTIANA		
Canker	*Phomopsis Pseudotsugae* Wilson	'Fifeshire' (Wilson, **17**, xxxv, 73)
TSUGA CANADENSIS		
Leaf Spot	*Keithia Tsugae* (Farl.) Durand	Tweed (Wilson, **14**, li, 46)
ULMUS spp. (Elms)		
*Dutch Elm	*Ceratostomella Ulmi* (Schwartz) Buism.	Tweed
An isolated occurrence on a felled tree.		
Leaf Spot	*Dothidella Ulmi* Wint.	Tweed, Solway, Clyde, Tay
Asteroma Ulmi Klotsch has been recorded from Forth, Clyde, Dee and Moray (Trail, **1**, 3rd Ser. i, 32; **1**, N.S. iv, 65; **1**, N.S. iii, 125) and *Piggotia astroidea* B. & Br. from Tweed, Forth and Tay (Trail, **1**, N.S. iii, 235).		
Heart Rot	*Fomes connatus* Fr.	Moray (Keith, **1**, ii, 247)
Fomes ulmarius (Sow.) Fr. is on record on elm in Forth (**9**, i, 296), Tay (**1**, v, 271) and Dee (**13**, p. 138), as is *Polyporus squamosus* (Huds.) Fr. on wych elm in Tweed (**11**, x, 243).		
Leaf Spot	*Septogloeum Ulmi* (Fr.) Died.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray (Trail, **1**, N.S. iii, 232)
Brown Slime Flux	*Fusarium* sp. and *Oospora lactis* (Fresen.) Sacc., associated	Dee (Ogilvie, **3**, ix, 171)

MISCELLANEOUS

HOP		
*Downy Mildew	*Pseudoperonospora Humuli* (Miyabe & Tak.) G. W. Wilson	Dee
*Mildew	*Sphaerotheca Humuli* (DC.) Burr.	Solway, Clyde, Tay, Moray
FLAX		
*Seedling Blight	*Colletotrichum Lini* (Westerd.) Toch.	
*Browning	*Polyspora Lini* Laff	
*Damping Off	*Botrytis cinerea* Pers. f. *Lini* van Beyma Thoe Kingma	
All common on Scotch-grown flax seed received at the Seed Testing Station. Rust (*Melampsora Lini* Desm.) is prevalent on *Linum catharticum* (Wilson, **7**, xxxi, 423), but is so far not recorded on cultivated flax.		
TIMBER		
*Dry Rot	*Merulius lachrymans* (Wulf) Fr.	Tweed, Solway, Forth, Clyde, Tay, Dee, Moray, Argyll
Dry Rot	*Lenzites saepiaria* (Wulf) Fr.	Forth (Wilson, **7**, xxxi, 476)
*Dry Rot	*Coniophora puteana* (Schum.) Karst.	Tweed, Forth, Clyde, Tay, Moray
Dry Rot	*Lentinus lepideus* Fr. and *L. adhaerens* (A. & S.) Fr.	Forth (Wilson, **7**, xxxi, 477), Clyde (**6**, N.S. iv, 394)
ROTTING OF JUTE BAGS		
*Rot	*Merulius lachrymans* (Wulf) Fr.	Tay

ENTOMOGENOUS FUNGI

**Empusa Muscae* Cohn	On house-flies	Solway, Forth, Tay
Empusa Aulicae Reichhardt	On caterpillars	Tay (Petch, **3**, xvii, 170)
Empusa Fresenii Nowak.	On aphides	Moray, Sutherland (Cotton, **3**, vi, 201)
**Entomophthora Lampyridarum* Thaxter	On heather beetle	Forth (Det. T. Petch)
**Entomophthora Aphidis* Hoffm.	On aphides	Forth, Moray (Det. T. Petch)
**Cordyceps militaris* (L.) Link	On pupae	Solway, Forth, Clyde, Tay, Moray
**Cordyceps Forquignoni* Quélet	On a fly	Clyde (Det. T. Petch)

? *Cordyceps sphecocephala* (Kl.) Cooke	On a wasp	Moray (Petch, **3**, xvii, 173, citing Keith, **1**, ii, 365)
**Cephalosporium aphidicola* Petch	On strawberry aphis	Clyde (Det. T. Petch)
Metarrhizium Anisopliae (Metsch.) Sor.	On *Sitones* larvae	Moray (Petch, **3**, xvii, 174)
Beauveria Bassiana (Bals.) Vuill.	On *Sitones lineatus*	Moray (Petch, **3**, xvii, 174)
Cladosporium Aphidis Thüm.	On aphides	Moray (Cotton, **3**, vi, 203)
**Isaria farinosa* Fr.	On pupae	Solway, Forth, Clyde, Tay, Moray
'*Isaria arachnophila*' Ditm.	On spiders	Forth (Trail, **1**, 3rd Ser. i, 33), Clyde (Boyd, **5**, iv, 17), Tay (White, **1**, v, 325)
Akanthomyces aculeata Lebert	On moths	Solway (Petch, **3**, xvii, 176)
Hirsutella Eleutheratorum (Nees) Petch	On a beetle	Dee (Trail, **1**, N.S., iii, 172)

For Scottish Laboulbeniales see Bisby and Mason (**3**, xxiv, 131).

REFERENCES

The references in the body of the text are to be interpreted as follows: the first number in Clarendon type refers to the item in the list below; the second number in roman numerals, gives the volume, and the third number, in arabics, the page. Items 2 and 4 below are issued without volume numbers and in these the date of the volume replaces the roman numerals.

(**1**) *Scottish Naturalist.*
(**2**) *Annals of Scottish Natural History.*
(**3**) *Transactions British Mycological Society.*
(**4**) *Annual Reports Scottish Cryptogamic Society.*
(**5**) *Glasgow Naturalist.*
(**6**) *Transactions and Proceedings Natural History Society of Glasgow.*
(**7**) *Transactions Botanical Society of Edinburgh.*
(**8**) *Journal of Botany.*
(**9**) *Transactions Edinburgh Field Naturalists Society.*
(**10**) *Transactions and Proceedings Perthshire Society Natural Science.*
(**11**) *History Berwickshire Naturalists Society.*
(**12**) *Transactions Dumfries and Galloway Natural History Society.*
(**13**) Stevenson, J., *Mycologia Scotica.* Edinburgh (1879).
(**14**) *Scottish Forestry Journal.*
(**15**) Sampson, K. & Western, J. H., *Diseases of British Grasses and Legumes.* Cambridge (1941).
(**16**) Grove, W. B., *British Stem and Leaf Fungi.* 2 vols. Cambridge (1935, 1937).
(**17**) *Transactions Royal Scottish Arboricultural Society.*
(**18**) *Gardeners' Chronicle.*
(**19**) *Scottish Journal of Agriculture.*
(**20**) *Arb. aus der Biol. Reich anst. f. Land- u. Forstv.*
(**21**) *Nature.*
(**22**) *Annals of Botany.*
(**23**) *West of Scotland Agricultural College Research Bulletins.*
(**24**) *Annals of Applied Biology.*
(**25**) *Journal Board of Agriculture, London.*
(**26**) *Annual Reports Cheshunt Experimental and Research Station.*
(**27**) Wormald, H., *Diseases of Fruit and Hops.* London (1939).
(**28**) *Notes from Royal Botanic Garden, Edinburgh.*
(**29**) *Annual Reports Department of Plant Pathology, Seale-Hayne Agricultural College.*
(**30**) *Ministry of Agriculture and Fisheries Bulletins.*

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THE OCCURRENCE IN ARTIFICIAL CULTURE OF TREMELLOID OUTGROWTHS ON THE PILEI OF *COPRINUS EPHEMERUS*

By W. G. KEYWORTH

East Malling Research Station

(With Plate XI)

During 1937–8, while investigating the physiology of some Basidiomycetes at the Imperial College of Science and Technology, I obtained isolations of various species of *Coprinus* which formed fruit-bodies on incubated horse-dung, and one of these fungi was selected for culturing on artificial media. Its identity on the natural habitat was not determined but the fruit-bodies bore a close resemblance to those of *C. ephemerus*.

In the course of this work some of the fruit-bodies produced in artificial culture bore tremelloid excrescences. No critical observations were made at the time on their structure, but an account of the circumstances of their production may assist in answering some of the questions raised by previous observers of similar structures on other agarics.

All previous records of such structures on fungi are of specimens growing under natural conditions. The various records which have been made are well summarized by Buller (1924) and Ramsbottom (1933).

The structures were first regarded as parasitic and given the name of *Tremella mycetophila*. Later, this theory was discarded and they were then regarded as abnormal outgrowths of the fruit-body on which they were found. They were most commonly found on the pileus and stipe of *Collybia dryophila* but occasionally on *C. butyracea*, *Laccaria laccata* and *Collybia velutipes*. All observers describe a hymenium covering each outgrowth, bearing basidia with basidiospores; some record the presence of numerous minute catenate conidia within the outgrowths.

Ramsbottom (1933) describes three specimens of *Collybia dryophila* (found on an autumn foray in 1932) bearing tremelloid outgrowths on the pileus and stipe. No conidia were seen in sections of these specimens.

There have been many attempts to explain the production of such outgrowths on agarics. Buller records that one observer, Burt,

believed them to be induced by protracted wet weather during the period of development of the fruit-body. Buller tentatively suggested that the tendency to produce these outgrowths may be inherited, and Ramsbottom states that Ulbrich lists such malformations as mutations. Ramsbottom concluded that the structures he described were overgrowths from the pileus and stipe, and states that what was apparently a dipterous insect was occasionally seen in a cavity of the overgrowth. He suggested that renewed growth of hyphae at the surface of the pileus and stipe had occurred after normal growth had ceased.

During the course of my own investigation on the physiology of *Coprinus ephemerus* it was desired to determine whether variations in the air conditions under which the mycelium was growing would cause variations in the number or size of fruit-bodies produced. Thirty-three subcultures of the fungus, which had originally been grown from a single hyphal tip, were made in Petri dishes. These cultures were grown on an artificial medium consisting of glucose 0·4 g., sodium nitrate 1·4 g., potassium mono-hydrogen phosphate 0·8 g., agar 20 g., water 1 l. Eighteen of the cultures were placed in an apparatus which had been designed so that sterilized air could be passed over the surfaces of the cultures.

Fifteen control cultures in closed Petri dishes were stood in three piles on the laboratory bench beside the apparatus. All the cultures were exposed to normal daylight about four feet from a window.

After eighteen days, with an unstandardized stream of air passing through the apparatus, it was seen that the two sets of cultures were fruiting simultaneously and that the aeration did not hasten fruiting. However, about three-quarters of the fruit-bodies inside the chamber bore tremelloid excrescences on their caps, whereas those in the unaerated Petri dishes were quite normal. Some of the fruit-bodies produced in the aerated dishes had begun to deliquesce and the outgrowths were deliquescing at the same time.

Each outgrowth consisted of a much lobed and convoluted mass of white tissue covering the top of the cap and of about the same diameter as the unexpanded pileus. No outgrowths were seen which were distorted or enlarged in proportion to the cap, and each outgrowth appeared to be a perfectly proportioned and integral part of the cap on which it was growing.

As the significance of the formation of these outgrowths was not realized at the time no material was preserved for careful sectioning. A few hand sections were made, however, of abnormal fruit-bodies in various stages of development and some of these are illustrated in Pl. XI. These showed that each outgrowth developed at the same time as the pileus on which it was growing and was not formed after normal growth had ceased. When mature, each outgrowth was covered with a hymenium with basidia bearing spores indistinguish-

able from those on the gills. Each basidium was a single undivided cell. The hymenium on the outgrowth was very delicate and rapidly disintegrated on contact with any preservative so that all attempts to preserve or mount a portion of it failed. No conidia were observed within the tremelloid outgrowths.

Cultures were made by placing portions of the outgrowths on plain agar in test tubes. Mycelium readily grew from each portion and the cultures so formed eventually produced normal fruit-bodies.

The fact that the fungus was growing in pure culture and that subcultures from the outgrowths produced normal fruit-bodies precludes any possibility that the outgrowths were parasitic. They were obviously produced from the pilei on which they were growing. They were not the result of a mutation since no outgrowths were formed on similar unaerated cultures, and subcultures of the outgrowths formed normal fruit-bodies. They did not arise as a result of insect damage. They were produced, however, by an external stimulus, namely the exposure of the cultures to a stream of air. The humidity, temperature and pressure of the air were unknown but it is very probable that the air in the apparatus was drier and cooler than that in the closed Petri dishes.

The tremelloid outgrowths found in nature may be produced by some stimulus similar to that applied in this experiment. It is significant that outgrowths were present even on the youngest fruit-bodies and it is possible that they will not be found unless the mycelium from which the fruit-body is to grow is exposed and stimulated so that development of the outgrowth can start at the inception of development of the fruit-body and continue simultaneously with it. It is conceivable that once the normal fruit-body has grown beyond a certain stage the stimulation will have no effect upon it. These points, as also the precise conditions under which these outgrowths are formed, remain to be investigated.

The fact that under certain conditions these outgrowths are formed reveals, as is emphasized by Buller, that the fruit-bodies of some agarics may vary greatly in form in response to external stimuli whereas they were previously thought to be incapable of variation in structure beyond certain narrow limits.

Summary

During an experiment in which a stream of sterile air was passed over pure cultures of a species of *Coprinus* (probably *C. ephemerus*) fruit-bodies were formed bearing tremelloid outgrowths in their pilei. Similar cultures in closed Petri dishes developed normal fruit-bodies.

The production of such outgrowths under these circumstances

shows that they were not parasitic or the result of a mutation but were induced to develop by the condition of the air under which the cultures were growing.

My thanks are due to Prof. W. Brown for facilities and help in carrying out these experiments and to Dr L. Hawker for her interest in the work.

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EXPLANATION OF PLATE XI

Fig. 1. Mature fruit-body of *Coprinus ephemerus* bearing an outgrowth on the cap. × 10.

Fig. 2. Longitudinal section of a half-grown normal fruit-body. × 30.

Fig. 3. Longitudinal section of a very young fruit-body bearing an outgrowth. Gill cavities just visible. × 30.

Fig. 4. Longitudinal section of a half-grown fruit-body bearing an outgrowth. × 30.

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Fig. 1

Fig. 2

Fig. 3

Fig. 4

ON THE GENERIC NAME OF THE GRAM-POSITIVE BACTERIAL PLANT PATHOGENS

By W. J. DOWSON

Botany School, Cambridge

Although Gram's method of staining bacteria has become a routine practice in identification it is only within the last few years that bacteriologists have come to realize its probable significance arrived at by investigations of the mechanism of the differential staining. Henrici (1934), Kluyver and van Niel (1936) and others are of the opinion that the two classes into which bacteria and certain other organisms are so sharply divided by Gram's method of staining is in reality a reflexion of a fundamental difference between the proteins of the two groups, which are therefore considered to be not closely related. Thus the lower algae and fungi are Gram-negative, as are also the Protozoa, while the Actinomycetes, Mycobacteriaceae and Bacillaceae are Gram-positive. In applying the conception to genera it follows that a genus cannot include both Gram-positive and Gram-negative organisms.

Among the bacteria causing plant diseases the great majority are Gram-negative (Dowson, 1941), but there are six well-described species which are Gram-positive, and for these some genus other than those used for the Gram-negative forms must be sought. Bergey (1939) places them all in his genus *Phytomonas*: they are, *P. fascians* Tilford, *P. flaccumfaciens* (Hedges) Bergey, *P. insidiosa* (McCulloch) Bergey, *P. michiganensis* (Erw. Smith) Bergey, *P. sepedonica* (Spieckermann) Magrou and *P. Rathayi* (Erw. Smith) Bergey. As, however, the genus *Phytomonas* consists of Gram-negative motile green-fluorescent and yellow bacteria together with Gram-positive non-motile forms it is not acceptable to most bacteriologists, and has, moreover, been shown to be invalid (Elliott, 1937; Dowson, 1939). There has long been a genus *Corynebacterium* Lehmann & Neumann for certain bacteria which is defined by Bergey (1939, p. 791) as follows: '*Corynebacterium* Lehmann & Neumann, 1896. Slender, often slightly curved, rods with tendency to club and pointed forms, with branching forms in old cultures. Barred uneven staining. Not acid fast. Gram positive. Non-motile. Usually aerobic. No endospores. Some pathogenic species produce a powerful exotoxin. Characteristic snapping motion is exhibited when cells divide. The type species is *Corynebacterium diphtheriae* (Flügge) Lehmann & Neumann.' Jensen (1933, 1934) studied these bacteria in New South Wales and

constructed a tentative key for identifying them which is reproduced by Bergey (1939, p. 806). Jensen's description of the genus is: 'Non-motile bacteria without endospore formation, Gram-positive, not acid fast, generally rod-shaped but with a marked tendency to formation of irregular, club- or wedge-shaped, sometimes branching cells of a more varying size and shape than is usually found among the *Eubacteriales*, and multiplying by a characteristic "snapping" division of the cells, which causes the bacteria in microscopical preparations to appear in V- or III-like arrangements, or irregular groups sometimes compared to Chinese letters.' Among the species Jensen found to be abundant in certain grass soils were two closely resembling the pathogenic species *Phytomonas insidiosa* and *P. michiganensis*, authentic cultures of which were compared with the New South Wales saprophytes and as they proved to be identical, Jensen recommended the names *Corynebacterium insidiosum* and *C. michiganense* for them. Of the former Jensen (1934, p. 41) says: '*Aplanobacter insidiosum* McCulloch (McCulloch & Jones, 1926)...their careful description and instructive microphotographs leave no doubt that the organism was really a *Corynebacterium*'; and of the latter (1934, p. 47), 'this species has been carefully examined by Stapp (1930), whose fine microphotographs and generally good description leave no doubt that it is really a *Corynebacterium*. The same is evidently true of the closely related *Bacterium sepedonicum* (Stapp, 1930) and *Aplanobacter rathayi* (Smith, 1914).'

Both Hedges (1926) and Burkholder (1930) describe *Phytomonas flaccumfaciens* as having one polar flagellum, but Adam and Pugsley (1934) describe the organism as being non-motile as are the other five species. Burkholder (1930, p. 34) states that 'the longest rods often show a slight curve, and a few of the cells appear to be larger at one end than at the other', which is characteristic of the genus *Corynebacterium*. That *Phytomonas fascians* is also a species of *Corynebacterium* is evident from the descriptions of the organism given by the two investigators who have studied it in detail. Tilford (1936) states that, grown on potato dextrose agar U and V shapes are found, and that in older cultures 1–3 round bodies which are not spores, occur in the cells: and Lacey (1936) describes the growth as being filamentous in old cultures, frequently in groups forming Y's, W's, star-shapes and involution forms, and in old cultures intracellular bodies, not spores, are frequent. The grouping, U's, V's, Y's and W's are characteristic of the post-fission movements of *Corynebacterium*, and the intracellular bodies are due to irregular staining of the contents: both are recorded in most systems of classification.

In view of the above facts it is recommended that the names of the Gram-positive plant pathogens be as follows:

1. *Corynebacterium sepedonicum* (Spieckermann) n.comb., the cause

of bacterial ring rot of potatoes, first described by Spieckermann (1913). Not recorded in Britain.

2. *Corynebacterium Rathayi* (Smith) n.comb., the cause of yellow slime disease of cocksfoot, first described by E. F. Smith (1914). Occurs in Britain.

3. *Corynebacterium michiganense* (Smith) Jensen, the cause of the Grand Rapids disease or bacterial canker of tomatoes, first described by E. F. Smith (1914). Not recorded for Britain.

4. *Corynebacterium insidiosum* (McCulloch) Jensen, the cause of bacterial wilt of lucerne, first described by McCulloch (1925). Not recorded for Britain.

5. *Corynebacterium flaccumfaciens* (Hedges) n.comb., the cause of a systemic disease of beans (*Phaseolus*), first described and named by Hedges (1922) and more fully described by her in 1926. Not recorded for Britain.

6. *Corynebacterium fascians* (Tilf.) n.comb., the cause of fasciation of sweet peas and strawberry and of leafy galls on chrysanthemum, carnation, *Schizanthus* and other plants, described simultaneously by Tilford (1936) in America and by Lacey (1936) in England who later (1939) called the organism *Bacterium fascians*.

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SOME WATER MOULDS OF THE HOGSMILL RIVER COLLECTED FROM 1937 TO 1939

By GRACE M. WATERHOUSE
Royal Holloway College

(With 1 Text-figure)

The Hogsmill river is a minor tributary of the Thames, seven or eight miles long, rising in the High Street, Ewell (Surrey), and entering the main river at Kingston. Powerful springs issuing from the north side of the North Downs where Thanet sand meets the Upper Chalk come to the surface in four lakes alongside the village street and form the source of the river (Dewey & Bromhead, 1921). Similar springs in the neighbourhood give rise to most of the tributaries. The Hogsmill river though once famous for trout has not been a completely rural stream for some centuries. From 1589 to 1613 there were twelve gunpowder mills on its banks. These have been replaced by two flour mills and a brick, tile and pottery works. The effluents from these and from four sewage works, together with the drainage from 26·7 sq. miles (half of which is chalk land) augment the basic flow of spring water.

The average annual rainfall at Ewell is 26·5 in. and at Kingston-on-Thames 21·5 in. The river is usually fairly shallow (4–7 in. at the bank and 10–13 in. in midstream) and yet maintains a good flow throughout the year with a maximum in spring (usually in March but may be in February or as late as May), and a minimum, averaging about a quarter of the maximum flow at the source, in November. This seasonal variation in flow is due to the rise and fall of the springs. Continuous heavy rain causes a rise of a foot or more and occasionally in winter the river overflows its banks. There are no official records of it ever having dried up, possibly because of the constancy of the springs and sewage effluents. The normal rate of flow in midstream is 0·8 mile per hour.

The water is constantly alkaline and the *p*H shows an annual variation from 7·2 in winter and early spring to 8·0 in summer. The surface water is slightly more alkaline than the bottom water especially in dry weather. These records are comparable with those of Rice (1938) for the Thames. He attributed the annual fluctuation to the removal of carbon dioxide by green plants in summer and to the large amount of decaying matter in autumn. Chemical analyses made by the Thames Conservancy each year in spring show that between the source and the outflow there is a considerable increase in

sodium chloride, organic matter and nitrogen, both organic and inorganic, caused by the effluents. The hardness at Ewell is nineteen. Temperature, sunshine and other records were not made, but Rice (1938) gives full details for the neighbouring reach of the Thames, and reference to these would give a good idea of the conditions in the Hogsmill valley. During the two years when collections of water moulds were made, the outstanding features of the weather were the very dry spring of 1938 (total rain February–April only 0·68 in.) and the severe cold in December both in 1937 and in 1938. The river, however, was not frozen, nor is it known to have been frozen over for many years.

The region where the water moulds were collected lies in one of the few remaining rural parts of the river about midway along its course. Here it flows in a north-easterly direction in what is considered to be the abandoned valley of the river Mole. It is a wide alluvial valley in a region of London clay. The stream is about 17·5 ft. wide with banks 2·5 ft. high and a bed of soft black mud 5–6 in. deep. The banks are bordered by meadows, and the left (north) bank is overhung by trees—hawthorn, elder and ash (*Crataegus Oxyacantha*, *Sambucus nigra*, and *Fraxinus excelsior*). Once a year the Surrey County Council has the river cleared of vegetation and the banks trimmed. Consequently there are no large aquatic plants and few algae. This and the absence of trees to the south means that the river is fully exposed to the sun.

Methods of collection

The usual methods of setting bait were employed, the containers used being galvanized tins with holes punctured in the bottom and sides to permit the passage of water through the tin. At first various fruits and twigs were used as substrata either in the river or for fresh inoculations in the laboratory. Eventually tomatoes were used almost exclusively as these proved most satisfactory in rapidity and variety of infection and in the facility of examination provided by the thin transparent easily removable skin. Moreover, it was found that all species originally found on other bait grew well on tomatoes. In the laboratory the material was kept in glass jars in tap water (*p*H 8·0) which was frequently changed. It was thought to be unnecessary to attempt to get pure cultures except for species of *Pythium* and *Phytophthora* (including *Pythiomorpha*) which were transferred to agar cultures for identification. Cultures containing single species were obtained by placing a pustule or zoospores with fresh bait.

In the winter the first pustules appeared on tomatoes that had been in the river ten days. In July and September 1938 none were seen until after fourteen to seventeen days, and in May 1938 there were none until after twenty-three days' immersion.

Species encountered and their occurrence

Chytridiaceae

One chytrid, closely related to *Pleolpidium inflatum* Butler, parasitic in a species of *Phytophthora* has been described in detail (Waterhouse, 1940). No others were found during the two years, but in November 1941 *Pleolpidium Blastocladiae* von Minden appeared as a parasite in both *Blastocladia Pringsheimii* and *B. gracilis*. Numerous typical spiny resting spores were formed after two weeks.

Blastocladiaceae

Blastocladia Pringsheimii Reinsch.

As is usual, this species was the most abundant and constantly appearing of all the water moulds, apparently inactive in the stream only in August 1938 and 1939. This may have been due to the very low summer level of the river in both years, and perhaps the fungus may continue its activity unabated during a wet summer. It appeared also in its usual wide variety of form. Two types of thallus were encountered more frequently, (1) a globose form and (2) a branched form, corresponding to types A and C of Lloyd (1938). Resistant sporangia appeared intermittently, sometimes in profusion. They were never found on bait which had been in the river for a month during the autumn, winter and spring, until this bait had been kept in the laboratory for a month or two. In May, June and July, however, resistant sporangia were found on the bait when taken from the river. Some of the resistant sporangia were spherical, some shortly clavate, and others elongated and looking like zoosporangia converted into resistant sporangia.

Some of the resistant sporangia were germinated. Tomato skins which had borne plants with numerous sporangia in March 1938 were kept in water until July. They were then allowed to dry slowly from the end of July until the end of September. A day after flooding with tap water very many of the resistant sporangia discharged zoospores. Some of these settled down and germinated by means of a tube; others put with fresh tomatoes gave young plants (not visible to the naked eye) in twenty-four hours.

Blastocladia gracilis Kanouse.

In the early part of the year this species was sometimes more abundant than *B. Pringsheimii* but less so in the other months, and disappeared from June or July until October. Its most striking feature is the rapid and prolific production of resistant sporangia which appear within fourteen days from the time of inoculation. They are more constant in shape than those of *B. Pringsheimii*, being oval with a truncate

base and having a more transparent wall with less conspicuous pits (Fig. 1). In Denmark, Lund (1934) found that *B. gracilis* occurred all the year round but only in waters which were neutral or constantly alkaline. As he examined only lakes, ponds and pools, it is interesting to find this species occurring in the constantly alkaline Hogsmill river, thus extending Lund's observation to yet another type of water.

The resistant sporangia of this species were germinated in the same way as those of *B. Pringsheimii*. The fate of the zoospores thus produced was not followed, but young plants soon appeared on tomatoes put with the germinating spores.

This is the first record of *Blastocladia gracilis* in the British Isles:

Whole plant with rhizoids	1500 μ.
Zoosporangia average size	78 × 27·5 μ.
Resistant sporangia	45–55 × 30–38 μ.

Blastocladia ramosa Thaxter and *B. incrassata* Indoh

Occasional plants were found in November, December and January each year (Fig. 1). They were of the same size (600 μ) as those described originally by Thaxter (1896). A few plants had small zoosporangia comparable with Thaxter's specimens, but the zoosporangia and resistant sporangia of the majority of the plants were larger and corresponded in size with those of a specimen found by Sparrow (1936) in the vicinity of Cambridge, England. Indoh (1940) has suggested that Sparrow's plant belonged to a different species and has renamed it *B. incrassata*. As the size and form of the thallus is so variable among individual plants of the same species in this genus it may well be that the two forms are varieties of *B. ramosa*. They are similar in habit, branching and shape of sporangia.

Whole plant with rhizoids	600 μ.
Trunk	250 × 35–80 μ.
Zoosporangia	65–85 × 20–24·5 μ.
Resistant sporangia	34–38 × 20–28 μ.

Blastocladia glomerata Sparrow

A number of plants referable to this species were found on a tomato taken from the river in July 1939. The plants were small compared with other species of *Blastocladia* (Fig. 1). The zoosporangia were very variable in size, but on the whole rather short and broad. Occasional resistant sporangia were found.

Trunk	90–130 μ broad.
Zoosporangia	60–120 × 26–58 μ.
Resistant sporangia, average size	47 × 40 μ.

A few pustules composed of smaller plants than the above appeared on tomatoes in the river in September 1939. The zoosporangia were

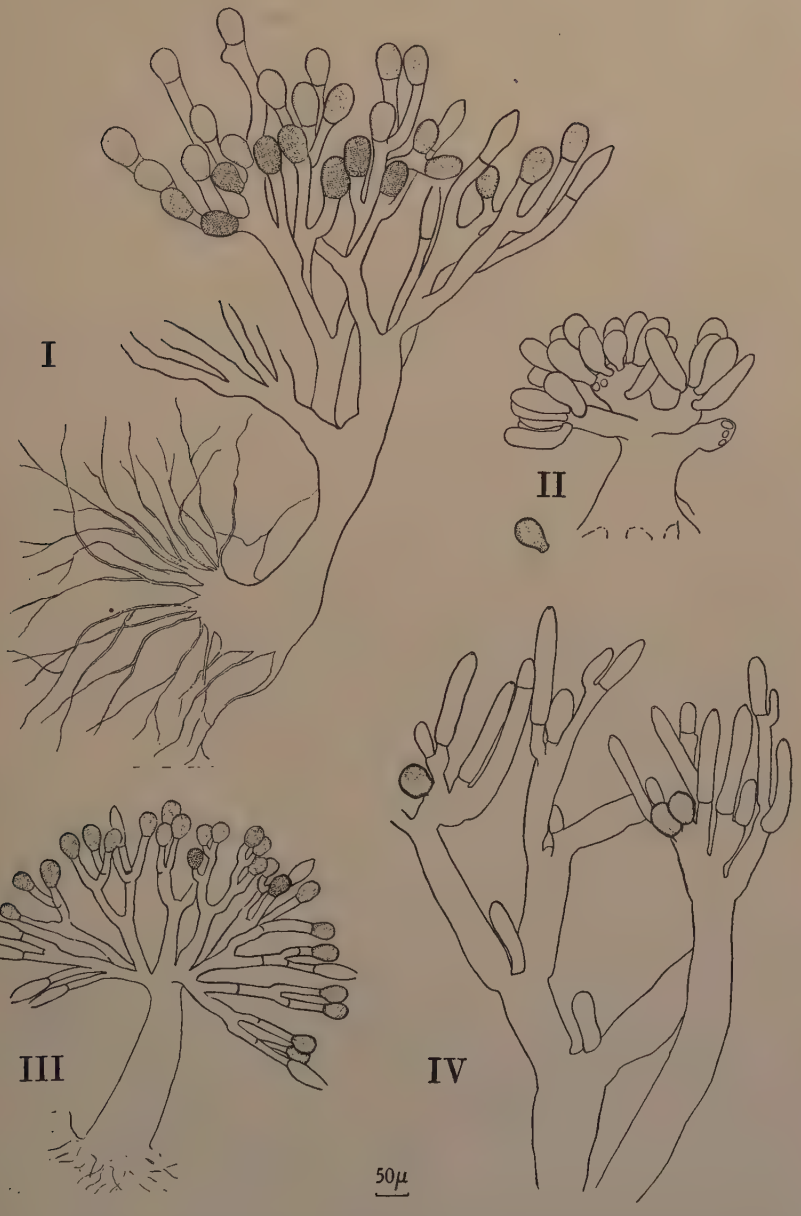

Fig. 1. Four species of *Blastocladia* from the Hogsmill River. I, *B. gracilis*. II, *B. glomerata*. III, *B. ramosa*. IV, *Blastocladia*? (All drawn to the same scale with camera lucida.)

shorter (average 60μ) and narrower (17–20μ). In longitudinal section their shape was like a foot sole. There was no papilla and no region taking a deeper stain in cotton blue which could be recognized as a papilla region. After the discharge of zoospores the apical part of the wall protruded as a short neck. The basal trunk of the thallus was short and then branched once or twice dichotomously, bearing three or four sporangia at the end of each branch. A few young resistant sporangia were found and they were similar to those of *B. glomerata*. This is probably a variety of that species.

Other species of *Blastocladia*:

(1) A species which could not be identified is shown in Fig. 1, IV. Plants were found once on a single tomato. They most nearly resembled the branched forms of *B. Pringsheimii* but differed from them in that the zoosporangia were borne singly on the ends of the branches, growth being continued sympodially.

(2) One or two plants which were thought to represent the species *B. truncata* Sparrow appeared in July 1938 and in July and August 1939. Both zoosporangia and resistant sporangia were present.

(3) A few globose plants resembling those described for the species *B. globosa* Kanouse were found after germination of resistant sporangia on dried twigs. The only feature which seems to distinguish *B. globosa* from the extreme globose forms of *B. Pringsheimii* is the brittle nature of the thallus. As this feature was not noticeable in the specimens examined it was presumed they were forms of *B. Pringsheimii*.

Gonapodyaceae

Gonapodya prolifera (Cornu) Fischer

This species was extraordinarily sporadic in its appearances. It would be found covering a tomato after long immersion and then suddenly die out even though fresh bait were put in to obtain a succession of growth. It suggests that the fungus requires a substratum at a certain stage of waterlogging and decay, and that fresh material is not suitable. Apple slices were tried but other hyphal Phycomycetes gained a foothold more readily and soon overran the *Gonapodya*. The best growth appeared during a hot spell in July 1938, which does not coincide with the findings of Sparrow (1933) who states that *Gonapodya* grows best at very low temperatures (8° C.). Other appearances were in May, June, July and October 1938 and May 1939. No reproductive organs other than zoosporangia were seen. These gave zoospores freely and the hyphae proliferated new sporangia several times within the original sporangium; the new ones never protruded beyond the previous one.

Sporangia 115–174 × 22–31·5μ, average 146 × 27μ.

Leptomitaceae

Rhipidium continuum Cornu (=*Rhipidium europaeum* von Minden)

The life history of this species was followed during the winter months when it appeared most abundantly. It was found to correspond closely with the description and figures of Behrens (1931). It was not encountered all the year round as some investigators found (Lund, 1934; Sparrow, 1936), but attacked bait from November to February (or March) only. It infected tomatoes rapidly, pustules appearing in nine to twelve days, and on two occasions in four and seven days. It occurred most abundantly after a very cold spell in December 1938. Oospores were frequent and formed after four and a half to seven weeks, the usual time being five weeks. This is longer than the time noted by Lund (1934) who obtained them after twenty-three days. The thallus was always of the compact plateau type bearing sporangia and oospores round the edge, suggestive of the variety *compactum* (Forbes, 1935). The variety with erect elongated hyphal branches bearing reproductive organs was not found. Attempts to germinate the oospores were unsuccessful although various coaxing methods were tried, viz. by storing in agar (Blackwell, 1937), both in a refrigerator (temp. 34° F.) and out of doors; by alternately drying and wetting and by treating with potassium permanganate (McKay, 1937) and Petri solutions. Some of the spores showed a gradual reduction of the thick wall to quite a thin layer, and the dispersal of the reserve food bodies accompanied by the extension of the protoplasm to fill the spore. These changes must have been a prelude to germination but none was observed. The noticeable increase of plants of *Rhipidium continuum* after a severe cold spell suggests that they originated from oospores caused to germinate by the cold. It is possible that treatment by freezing may induce germination under laboratory conditions.

Sporangia 41–78 × 18·5–22 μ, average 60 × 21 μ.
Oospores 27–37 μ diam.

Rhipidium americanum Thaxter

No sexual organs of this species were seen, although occasional spherical thick-walled spores were found, without, however, a definite antheridium. It was so different from *R. continuum*, even when growing on the same tomato, that it was taken to be *R. americanum* which it resembled very closely. It was not so abundant as *R. continuum*, and during the winter 1937–8 it was found only in January on twigs. During the following winter it appeared occasionally from November to February on bait in the river. It infected tomatoes rapidly, pustules appearing in four days.

Sporangia 50–80 × 26–34 μ, average 65 × 30 μ.

Saprolegniaceae

Species of *Saprolegnia* and *Achlya* occurred frequently on suitable bait, but it was decided not to include identification of these in the present investigation.

Pythiaceae

The genus *Phytophthora* (including *Pythiomorpha*)

Hyphal forms were frequently encountered which answered to the descriptions of species of *Pythiomorpha*. There were two types: A, with small sporangia (average size $39 \times 20\mu$) corresponding to *P. gonapodyides* Petersen; B, with larger sporangia (average size $54 \times 36{\cdot}5\mu$), and wider hyphae.

A was found thirteen times on old fruits which had been used as bait in the river during the winter months (October–February). In January 1938 it was found heavily parasitized by a chytrid closely related to *Pleolpidium inflatum* Butler.

B was encountered seven times in November, December and January, and once in May.

Agar cultures (bean, oat, cornmeal and malt) of both forms were made. A good growth was obtained on all four media, the aerial mycelium being especially fluffy on bean and oat. These cultures produced no reproductive organs except spherical swellings resembling chlamydospores, and in one culture a few misshapen sporangia. When portions of agar cultures were transferred to distilled water or Petri's mineral solution, abundant obpyriform, non-papillate sporangia were quickly produced. Secondary sporangia developed either by proliferation through an empty sporangium or by sympodial growth from below. The tendency to sympodial growth was more pronounced in portions floating at or near the surface of the water, whereas proliferation took place more on portions 2–3 cm. below the surface. This phenomenon has been noticed by other investigators and has been attributed to the fact that at the surface the more abundant air supply contributes to more rapid growth, and branching occurs before the sporangia are ready to dehisce or because they are inhibited from doing so by insufficient water supply. Repetitional emergence of zoospores was seen once. Oospores associated with the *Pythiomorpha* type of sporangium were found only once, and these were under the skin of a grape taken from the stream in December 1937.

These forms A and B were indistinguishable from species of *Phytophthora* belonging to the group which is characterized by its obpyriform, non-papillate sporangia, showing proliferation through empty sporangia, and producing reproductive organs sparsely or rarely (except chlamydospores) on solid media. The species of *Phytophthora*

included in this group are: *P. cambivora*, *P. Cinnamomii*, *P. cryptogea*, *P. Drechsleri*, *P. erythroseptica*, *P. Fragariae*, *P. megasperma*, *P. Porri* and *P. Richardiae*.

Form B most nearly resembled *P. cambivora* and A resembled *P. cryptogea*. The invalidity of the genus *Pythiomorpha* has been recently shown (Blackwell, Waterhouse & Thompson, 1941), and these forms are now referred to the genus *Phytophthora*.

The genus *Pythium*

A species of *Pythium* with large spherical sporangia (diameter 22–29μ) made its appearance in most months on bait which had become old and decayed. It was the only fungus recorded in the stream in August 1938. The sporangia were abundant and always spherical with a short lateral discharge tube. If they did not give zoospores the sporangia persisted for months on the bait and finally germinated by hyphae if given fresh media. No sexual organs were obtained either on the bait or in cultures of agar, carrot slices and hemp seed, and it has therefore not been possible to identify this species.

The genus *Pythiogeton*

A *Pythium*-like fungus with oval asymmetrical or spherical sporangia on very thin hyphae was encountered occasionally (once in abundance in July 1938), but the discharge of zoospores was not witnessed. It is referred temporarily to this genus. The sporangia were usually terminal, but occasional subterminal ones were observed. It was very probably *Pythiogeton uniforme* Lund.

Conclusions

Previous recordings of the occurrence of water moulds have been made for ponds, lakes, ditches and small streams. No rivers have been investigated in detail.

In the Hogsmill river most of the moulds have a seasonal rhythm, appearing in September or October, rising to a maximum in December, January and February, and disappearing in summer. One species of *Pythium* is the only fungus which has appeared in all months. On the contrary, in permanent ponds and lakes many moulds, though declining in activity in summer, are still to be found on bait all the year round. The autumnal onset of renewed growth is correlated with the increased rainfall (and therefore flood water), the abundance of suitable substrata (falling fruits and twigs), the declining temperature, and possibly the change in hydrogen-ion concentration. The disappearance in summer is most likely due to rise in temperature, falling water-level, and decrease in hydrogen-ion concentration. The competition with algae in summer is not apparent in the reach of the river studied because of the annual clearance of the river. As the river does

not dry up, drought is not a factor contributing to cessation of activity. A seasonal rhythm in the growth cycle with a period of complete inactivity is perhaps surprising in a body of water which maintains a good flow throughout the year, and shows that lack of water is not the only factor causing a cessation of growth. The temperature does not reach such extremes in a river as in ponds and lakes, especially shallow ones, and should therefore have less effect as a limiting factor. It is possible that the fall in hydrogen-ion concentration, correlated with decreased flow of the river in summer, may be important in controlling the activity of the fungi. It may be found in years with different weather conditions, e.g. a much wetter spring and early summer, that there is no summer inactivity. The relative percentage of sewage effluent to river water at different times of the year has not been investigated, but it is possible that it may affect the growth of fungi either by changing the hydrogen-ion concentration, or in some other way. The sporadic appearance of some species may be due to their transport from higher reaches and even from sewage and factory effluents. Consequently the fungous flora of a river is subject to change and though perhaps less rich than the still water flora, is relieved of the monotony which may be characteristic of isolated ponds and lakes.

I acknowledge with gratitude the help given by the Thames Conservancy, and by Mr Lloyd and the staff of the Kingston Borough Sewage works in providing details of chemical analyses and rates of flow. The work was carried out partly in the Botanical Department of Royal Holloway College, and the paper has been condensed from part of a thesis submitted for the M.Sc. Degree at the University of London. My sincere thanks are due to Miss E. M. Blackwell, M.Sc., for suggesting the investigation and for her constant encouragement and advice.

Summary

The Hogsmill river is a Surrey tributary of the Thames with constantly alkaline waters maintaining a good flow throughout the year, neither freezing nor drying up.

A short account is given of the sources of the water, seasonal variation in flow, chemical analyses and annual *p*H range.

Of the water moulds only the Phycomycetes are recorded, and of these the family Saprolegniaceae is omitted.

The species described are: *Blastocladia Pringsheimii*, *B. gracilis*, *B. ramosa*, *B. glomerata*, *Gonapodya prolifera*, *Rhipidium continuum*, *R. americanum*, *Phytophthora* (=*Pythiomorpha*) spp., *Pythium* sp., *Pythiogeton uniforme*, *Pleolpidium Blastocladiae*, and a chytrid related to *Pleolpidium inflatum*.

Blastocladia gracilis and the two chytrids are recorded for the first time in the British Isles.

Most of the moulds show a definite seasonal rhythm with maximum growth in winter and disappear in summer. Exceptions are a species of *Pythium* which is found in all months, *Gonapodya prolifera* which is very sporadic in its appearances, and the rarer species of *Blastocladia* which are only apparent when the more prolific species have died out.

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VOLVARIA SURRECTA (KNAPP) COMB. NOV.

By J. RAMSBOTTOM

(With 1 Text-figure)

While waiting for a bus I casually glanced through a dilapidated copy of the third edition of *The Journal of a Naturalist* outside a second-hand book shop. I remembered that this work contained a description and plate of *Mycena crocata*. The plate was there and also the description, but the fungus is not given a name except that of 'stainer' until the fourth edition (1838)—*Agaricus infector*; the plate first appears in the second edition. To my surprise I discovered a text-figure of a *Volvaria* with a description of the fungus under the name *Agaricus surrectus*. The figure does not appear in the first edition, 1829, from which the following is taken, p. 363: the figure is from the second edition, p. 378 (also 1829):

'We have even an agaric, with a bulbous root and downy pileus,* that will spring from the smooth summit of another (agaricus caseus), which has a uniform footstalk, though not of common occurrence. Thus a plant, that itself arises from decay, is found to constitute a soil for another; and the termination of this chain of efficiency is hidden from us.'

The description and figure clearly refer to the species Berkeley named *Agaricus* (*Volvaria*) *Loveianus* (*Outlines Brit. Fungi*, p. 140 (1860)), *Volvaria Loveiana* (Berk.) Quél.

Though *The Journal of a Naturalist* was published anonymously it is well known that the author was John Leonard Knapp (1767–1845). When he wrote he was living at Alveston, Glos., 'not favourably circumstanced for any great abundance of the race of fungi', but he had previously resided for some years in Monmouth, whose 'deep dark woods, and alpine downs' made it particularly favourable for most of the kinds. 'A residence in that portion of the kingdom for

* This agaric is, I believe, unnoticed. I have called it agaricus surrectus.

'Pileus—convex, expanding, covered with a pile of short, white hair; centre depressed; faintly tinted with yellow; from one to three inches in diameter.

'Laminae—loose, irregular, generally four in a set, rather numerous, broad, white, changing to buff, and then pink.

'Stipes—solid, tapering upwards, rather thick immediately below the pileus, three inches high, thick as a reed, white, and often downy, wrapper at the base.

'Many specimens of this singular plant I found in October, 1819, springing from a confluent mass of a. caseus. Bolton's a. pulvinatus is something like our plant; but he describes his under side as perfectly flat, and represents a singularity in the termination of his laminæ, which is not observable in our a. surrectus.'

Agaricus caseus With. is *Clitocybe nebularis*; *Agaricus pulvinatus* Bolt. is *Amanitopsis vaginata*.

some years introduced to my notice a larger portion of this singular race than every botanist is acquainted with. A sportsman then, but I fear I shall be called a recreant brother of the craft, when I own having more than once let my woodcock escape, to secure and bear away some of these fair but perishable children of the groves.'

Certainly a much greater space is given to fungi than is usual in such works and there is a good deal of unusual information about different species. 'That this elegant race has attracted so few votaries many reasons may be assigned. The agarics in particular are very

Agaricus surrectus (× ⅔).

versatile in their nature, and we frequently want an obvious, permanent character, to indicate the species, affording sufficient conviction of the individual. The rapid powers of vegetation in some will change the form and hues almost before a delineation can be made, or an examination take place, requiring nearly a residence with them to become acquainted with their various mutations; and we have no method of preserving them to answer the purpose of comparison. These are all serious impediments to the investigation of this class; yet, perhaps, I may with some confidence suggest, that any one, who is so circumstanced as to afford the time, so situated as to find a supply of these productions, and will bestow on them a patient

examination, will find both pleasure and gratification in contemplating the beauty, the mechanism, the forms, the attitudes, of the whole order of fungi.'

From the description and figure it is clear that Knapp's specific epithet must be used for the fungus. The change of name is of little consequence as the species is rare: it would be unknown to most botanists but for its parasitic habit.

It may be well to point out that if Konrad and Maublanc be followed in regarding the fungus as a subspecies of *Volvaria hypopithys* (Fr.) Karst., the name *V. hypopithys* subsp. *Loveiana* Konrad & Maubl. would be correct.

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PHIALEA MUCOSA SP.NOV., THE BLIND-SEED FUNGUS

By ELIZABETH G. GRAY

Department of Mycology, University of Edinburgh

The occurrence of low germination in seed crops of perennial rye-grass has been investigated since 1923 in New Zealand, where it was ascribed to infection with *Pullularia* (Hyde, 1938). In an account of the 'Blind-seed Disease of Rye-grass' (Neill & Hyde, 1939), a technical description was given, and it was stated that 'the blind-seed fungus appears to be allied to *Helotium herbarum* Fries, both in the ascosporic and conidial stages, and therefore, pending a clarification of the systematics of the family, is tentatively placed in the genus *Helotium* Fries'. In culture the fungus formed a 'mycelium of the "*Pullularia*" type'.

The fungus first isolated in Britain from seed samples showing low germination was *Pullularia pullulans* (de Bary) Berkhout (Noble, 1939), and, as detailed descriptions and cultures had not then been received from New Zealand, this was assumed to be the fungus of Hyde's account. It was soon found that both the 'blind-seed fungus' and *Pullularia* sp. are frequently present on the same grain (Wilson, Noble & Gray, 1940*a*). Examination of the two fungi showed that they differ in many respects and that the 'blind-seed fungus' could not be associated with the genus *Pullularia*.

At an early stage of our investigation of low germination in rye-grass, we noted the resemblance between the 'blind-seed fungus' and *Endoconidium temulentum* Prill. & Delacr. (1891), a parasite of rye (Wilson *et al.* 1940*b*). Its perfect stage has been assigned in turn to the genera *Phialea* (Prillieux & Delacroix, 1892), *Stromatinia* (Prillieux, 1897) and *Sclerotinia* (Rehm, 1915). Measurements of apothecia, ascospores and microconidia agree closely in the two fungi and the microconidia in all are developed endogenously. Macroconidia have not been described for *Sclerotinia temulenta* and the war has made it impossible to obtain material for comparison. Flowering rye has been successfully inoculated with the 'blind-seed fungus', but apothecia have not so far been obtained from infected rye grains.

It is desirable that the systematic position of the 'blind-seed fungus' should be determined, but the conclusions reached here must be considered tentative until its relationship with *S. temulenta* has been established or disproved.

The 'blind-seed fungus' is an inoperculate discomycete and has features in common with *Sclerotinia*, *Ciboria*, *Helotium*, *Phialea* and more especially with the subgenus *Stromatinia*. It has not been found possible to reach a satisfactory determination based on gross morphological structure. In pursuance of the methods adopted by Nannfeldt (1932), anatomical investigations were made of fresh or dried material of representative species in each genus. Thus fresh material of *Sclerotinia sclerotiorum* (Lib.) de Bary, *Helotium pallescens* (Pers.) Fr. and *Phialea cyathoidea* (Fr.) Gill., and herbarium specimens from the Royal Botanic Garden, Edinburgh, of *Sclerotinia* (*Stromatinia*) *pseudotuberosa* Rehm (Sydow, *Mycotheca germanica*, 2950), *Ciboria caucus* (Reb.) Fuck. (Petrak, *Flora Bohemiae et Moraviae exsiccata*, II, 1, 31, no. 1502), *C. amentacea* Fuck. (Phillips, 116), *Helotium fructigenum* Karst. (Cooke, *Fungi Britannica Exsiccati*, ed. 2, 392), *H. herbarum* (Pers.) Fr. (Sydow, *Mycotheca germanica*, 2724), *Phialea cyathoidea* (*Herb. mycol.* M. C. Cooke, 1885, 24, R. H. Paterson and Phillips, *Elvellacei Britannica*, 79), and *P. strobilina* Sacc. (Phillips, 40 *bis*) were examined, while photographs of *Sclerotinia Candolleana* (Lév.) Fuck. (Wilson & Waldie, 1927), *S. Ficariae* Rehm, *Helotium carpinicola* Rehm, *H. epiphyllum* Fr. and *H. conformatum* Karst. (Nannfeldt, 1932) were also studied. Descriptions given by Starbäck (1895), Durand (1900), Lagarde (1906), von Höhnel (1918) and Nannfeldt were used as additional evidence, although Durand's statements were not always in agreement with the results of observations of European material.

As will be seen from the technical description, the structure of the apothecium of the 'blind-seed fungus' is very uniform and consists throughout of parallel hyphae, forming a typical 'textura porrecta' (Starbäck, 1895), with a very slight tendency to irregularity in the centre of the excipulum immediately under the hypothecium.

In *Sclerotinia*, *Stromatinia* and *Ciboria* the excipulum consists of two layers, the inner of a loose 'textura intricata' and the outer of short-celled hyphae, which turn obliquely outwards and terminate at right angles to the surface. In *Helotium* the excipulum consists of two layers, the inner of a loose 'textura intricata' of slender hyphae, and the outer of wide hyphae which form a 'textura oblita'. In *Phialea* the excipulum consists of slender parallel hyphae which form a 'textura porrecta' in the stalk and merge into a 'textura oblita' under the hypothecium.

Within the genera examined, the anatomy of the apothecium provides a very reliable taxonomic character. The 'blind seed fungus' accords fairly closely in structure with species of *Phialea* and differs markedly from the other genera. Little is known of conidial stages in *Phialea*, but it is hoped that some species may be studied in culture this summer. Meanwhile it is proposed to assign the 'blind seed fungus' to the genus *Phialea*. The specific epithet *mucosa* has been chosen

on account of the slime formed by the macroconidia among the glumes of infected inflorescences.

The only important difference between the description by Neill and Hyde (1939) and that given below lies in the account of the endogenous development of the microconidia. The taxonomic significance of this character is not clear, but recent studies of life histories in the Helotiaceae show it to be of moderately frequent occurrence.

Phialea mucosa n.sp.

Apothecia small, fleshy, arising singly or in small numbers, 1–7, usually 1 or 2, from colourless, septate, intertwining hyphae, 3–4μ wide, ramifying throughout the pericarp, testa and endosperm; discs pale pinkish cinnamon, darkening to cinnamon when old, 1–3·5 mm. in diameter, most frequently 2·5 mm., at first almost closed, opening into a cup shape and finally becoming flat or slightly recurved, with a smooth margin; stalks cylindrical, 1–8 mm. long, 0·4 mm. in diameter, smooth; structure fairly uniform throughout, consisting of hyaline, parallel hyphae, occasionally intertwining and seldom branched, forming a 'textura porrecta' with cells in the stalk 20–30 $\times$ 3–4μ, grading into the more interlaced hyphae of the excipulum, with cells 18–24 $\times$ 4–6μ, passing gradually into the hypothecium, which is 22–27μ deep, composed of fine, interlacing hyphae, 2μ broad; asci cylindrical-clavate, very little thickened at the apex, the pore not staining blue with iodine, 66–116 $\times$ 3·3–7μ, most frequently 73 $\times$ 6μ, 8-spored; ascospores smooth, unicellular, ellipsoidal, with pointed ends, biguttulate, hyaline, 7·6–12 $\times$ 3–6μ, most frequently 9·5 $\times$ 4·5μ, obliquely uniseriate in the upper half to three quarters of the ascus; on germination each ascospore produces first a terminal germ tube and then a second, frequently lateral in position and usually constricted at the point of origin; paraphyses simple, filiform, hyaline, not swollen at the apex, 2–4μ broad;

Macroconidia unicellular, uninucleate, cylindrical to slightly crescentic, with rounded ends, usually biguttulate, hyaline, 11–21 $\times$ 3·3–6μ, most frequently 16 $\times$ 4μ, developed in summer in very large numbers in succession from the apices of short outgrowths from the hyphae on the pericarp, forming a pink slime on the surface of the ovary; in germination a transverse septum forms, two germ tubes are developed, one from each cell, the first terminal, the other terminal or lateral, or the conidium may remain unicellular and produce only one terminal germ tube;

Microconidia in pink, pulvinate sporodochia, 1–1·5 $\times$ 0·5 mm., on the surface of caryopses; conidiophores septate, guttulate, hyaline, two or three times branched; microconidia unicellular, uninucleate, ovoid, guttulate, hyaline, 3·4–4·8 $\times$ 2·7–3·2μ, most frequently 4 $\times$ 3μ,

the first formed by a constriction below the apex of the conidiophore, the rest developed in succession inside a tube, $5 \times 3\mu$, formed by the terminal portion of the conidiophore; germination not observed; on *Lolium perenne* Linn. and *L. multiflorum* Lam.; apothecia on dead or occasionally on germinated caryopses, in June; macroconidia on the ovary throughout the summer; microconidia on caryopses on the soil, usually in February and March, occasionally found until June; macroconidia by inoculation on *L. temulentum* Linn. and on *Secale Cereale* Linn.

Phialea mucosa sp.nov.

Mycelio hyalino, sub superficie caryopsidis effuso, 3–4μ lato;

Ascomatibus nunc singulariis, nunc gregariis in una caryopside, gracilibus, carnosis, primum cyathoideis dein applanatis, stipite cylindrico, usque ad 8 mm. longo, 0·4 mm. diametro, disco 1–3·4 mm. diametro, plerumque 2·5 mm., pallido-roseo-cinnamomeis, margine leve, textura omnino porrecta; ascis cylindrico-clavatis, apice vix incrassatis, 66–116 × 3·3–7μ, plerumque 73 × 6μ, parte sporifera 50–75 %, octosporis, iodo non coerulescentibus; sporidiis levibus, ellipsoideis, biguttulatis hyalinis, 7·6–12 × 3–6μ, plerumque 9·5 × 4·5μ, oblique monostichis; paraphysibus simplicibus, filiformibus, hyalinis, apice non incrassatis;

Conidiis dimorphis, exogenis endogenisque;

Macroconidiis exogenis, cylindraceis vel lunatis, apicibus rotundatis, biguttulatis, hyalinis, 11–21 × 3·3–6μ, plerumque 16 × 4μ, singillatim in hyphis brevibus successive natis, dein in massas mucosas in superficie caryopsidis coactis;

Microconidiis in sporodochiis pulvinatis roseis, 1–1·5 × 0·5 mm., in superficie caryopsidis; conidiophoris septatis, guttulatis, hyalinis, bis vel ter repetitio ramosis; microconidiis ovoideis, guttulatis, hyalinis, 3·4–4·8 × 2·7–3·2μ, plerumque 4 × 3μ, in interiore ramulorum sporophori nascentiis, dein liberis;

In caryopsidibus *Lolii perennis* Linn. et *L. multiflori* Lam., ascomatibus junio, macroconidiis per aestatem, microconidiis februario martioque.

The 'blind-seed disease' of rye-grass is being studied at the Plant Pathology Laboratory of the Department of Agriculture for Scotland and at the Mycology Department, Edinburgh University. Results of investigations will be published in due course.

I should like to thank Dr Malcolm Wilson and Dr Mary Noble for their advice and assistance with the work, which has been carried out during the tenure of a scholarship awarded by the Carnegie Trust for the Universities of Scotland.

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GLOEOSPORIUM NICOLAI AGGÉRY AND *GLOEOSPORIUM POLYPODII* AGGÉRY

LOOKING through Mlle B. Aggéry's thesis, *Quelques maladies nouvelles des Fougères*, 1935, for possible new genera I was struck by the appearance of the drawings of two fungi described as *Gloeosporium Nicolai* n.sp. and *G. Polypodii* n.sp., the former on *Scolopendrium officinale*, the latter on *Polypodium vulgare*, *P. vulgare* var. *serratum* and *Aspidium aculeatum*.

The drawings and descriptions are conclusive that *Gloeosporium Nicolai* is *Milesia* [*Milesina*] *Scolopendrii* and *Gloeosporium Polypodii* is *Milesia Polypodii* (*Milesina Dieteliana*): the form of *Gloeosporium Polypodii* on *Aspidium aculeatum* is probably *Milesia Whitei*.

In no notice of the thesis I have seen is there any suggestion that the author has misidentified fern rusts as Hyphomycetes. In the ordinary course one would not have called attention to the error except in synonymy. The account of these fungi, however, occupies thirty-nine pages and is illustrated by three coloured plates and forty text-figures. Many new facts are given about the formation and structure of the pustules, the formation and germination of the spores, spore dispersal, penetration of the host, haustorial formation, and the effect of the fungi on the vegetative and reproductive structures of the hosts. It is very careful work and should not be overlooked by those interested in fern rusts.

It is unfortunate that when the author was compiling a list of *Gloeosporium* spp. occurring on ferns she should have overlooked, or not appreciated, the significance of the footnote to *G. Frankii* in Rabenhorst, *Krypt.-Fl.* VII, 494 (1903), for otherwise the form and size of the spores, with their spinous membranes, would have led her to the relevant literature.

J. RAMSBOTTOM

(*Accepted for publication* 3 *February* 1942)

MACOWANIA, HYPOCHANUM OR *MACOWANITES*?

By J. RAMSBOTTOM

THE compilation of a dictionary of fungi provides much of historical and taxonomic interest and many puzzles. Among the latter is the question whether *Macowania*, *Hypochanum*, or *Macowanites* is the correct name for the Gasteromycete described by Kalchbrenner.

The genus was first diagnosed by Kalchbrenner with the name *Macowania* in a paper by M. J. B.[erkeley], 'Two new fungi' in *Gard. Chron.* n.s. v, 785 (1876); the second new fungus was the genus *Kalchbrennera* Berk. The date of publication was 17 June.

It has been generally overlooked that in *Gard. Chron.* n.s. vi, 140 (1876), the number for 29 July, there is a note by Berkeley in which he says, 'We have received a letter from the Rev. G. Kalchbrenner, in which he proposes to substitute for *Macowania* the generic name of *Hypochanum*.' There is good excuse for the oversight, for the sentence is in a general note on fungi among what are usually called 'editorial notes', though it is signed 'M.J.B.' It was, however, appended by W. G. Smith to a reprint of Berkeley's paper in *J. Bot.* xiv, 248 (1876): he added, 'A change is desirable, for Prof. Oliver has already published a genus of Compositae under the former name'; this was in Hooker's *Icones Plantarum*, 1870. The date of this reprint was August.

So far it is plain sailing if we accept the usual view that there should not be homonyms in the different phyla of the plant kingdom. But there is an unusual complication. The descriptions in Berkeley's paper were translated into German and published in *Hedwigia*, xv, 115 (1876), with copies of W. G. Smith's woodcuts which illustrated the original article. The generic name *Macowania*, however, is changed to '*MacOwanites* Kalchbr.' The date of publication was August. The genus is given by De Toni in Saccardo, *Sylloge Fung.* vii, 179 (1888) as '*Macowanites* Kalchr. in *Gard. Chron.* 1876, p. 785 (Etym. a MacOwan cui genus merito dicatun). *Macowania* Kalchbr.' Apparently this has led to the belief that Kalchbrenner himself changed the name, and the change has been generally adopted, e.g. Fischer in Engler and Prantl, Clements and Shear, Coker and Couch, Gäumann.

As *Macowania* is untenable as a fungus name, which of the other two shall be adopted? *Hypochanum* is obviously the valid name on grounds of priority, but can *Macowanites* be conserved?

In view of the published facts this at first appeared impossible. There seemed to be no way out of regarding the name *Macowanites* as a *lapsus calami*. The genus had been published on 17 June. The paper had to be translated and the woodcuts made, before publication could be achieved in *Hedwigia* some time in August. It seemed

most unlikely that Kalchbrenner would write to Berkeley to ask him to change the name and at practically the same time arrange for another name to be published. If a slip had been made who was responsible? Was it logical to validate it with an attribution to Kalchbrenner, for Berkeley (or the translator) or Rabenhorst (the editor of *Hedwigia*) might have been responsible; indeed Rabenhorst might have acted *ultra vires* as editor and made the change.

It seemed a strange error, however, for the ending 'ites' is unusual except for fossil fungi though not unknown, e.g. *Syzygites*, *Cordierites*, *Rozites*, *Sabouraudites* and the absurd *Stalagmites*.

There the matter stood until I found that in *Grevillea*, x, 107 (1882), Kalchbrenner had repeated the generic description (a practice customary with him) with the name *Macowanites*. 'Nomen "Macowania l.c. adhibitum" mutandum erat, cumjam pro genere phanerogamo consumtum sit.' He adopted the change but the question remained whether he was responsible for it. The Berkeley correspondence, which has been moved from the Department of Botany for the time being, contains a letter which settles the problem. On 26 August 1876 Kalchbrenner wrote thanking Berkeley for an extract from the *Gardener's Chronicle* 'MacOwan me quoque attentum addidit, et sic, in litteris ad Rabenhorstium nomen "Mac Owania" in "Mac Owanites" mutavi. Serius tantum mihi innotuit, quod in Bot. Journ. nominis mutatio per vos jam sit facta.'

Thus Kalchbrenner had three bites at the cherry—*Macowania* June 1876, *Hypochanum* July 1876, and *Macowanites* August 1876.

I propose that *Macowanites* (with *M. agaricinus* as type) be conserved because of general usage against *Hypochanum* which to all purposes was stillborn.

The letter mentioned by Berkeley in his note is missing from the correspondence. There are indeed only three letters. In the first, 29 May 1875, Kalchbrenner writes that E. Fries had recommended Berkeley to him as the highest authority on exotic fungi and asks for assistance as he is remote from libraries and has few books and he now has friends in South Africa* and New Holland† (Australia) who are sending him specimens; he could submit drawings and specimens with descriptions for Berkeley's revision. 'Ut in mycologia, ita etiam in Theologia collegan Te saluto.' In the second, 30 April 1876, he thanks Berkeley for a letter of 17 April. Berkeley had apparently accepted *MacOwania* as a new genus and had decided that an *Aseroe* (*Lysurus Tuckii* MacOwan) was also generically distinct. Berkeley had apparently offered to publish the description of the latter and Kalchbrenner asks that he should add that of *Macowania* also, with a drawing which he sends together with full Latin descriptions. It is to be noted that Berkeley had no specimen of *Kalchbrennera*.

* Peter MacOwan. † Sir F. J. Heinrich von Mueller.

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PROCEEDINGS

Meeting held in the rooms of the Linnean Society of London, Burlington House, Piccadilly, London, W. 1, 14 November 1941.

The President, W. C. Moore, Esq., M.A., in the Chair

F. L. Stephens and J. Ramsbottom. *Atichia.*

E. S. Twyman. *Colpoma quercinum.*

Discussion on Nomenclature. Art. 20 (*f*) of the International Rules.

'Legitimate botanical nomenclature begins... at the following dates:

'(*e*) Fungi: Uredinales, Ustilaginales and Gasteromycetes, 1801 (Persoon, *Synopsis methodica Fungorum*).

'(*f*) Fungi caeteri, 1821–32 (Fries, *Systema mycologicum*).'

The discussion was opened by Mr J. Ramsbottom. Miss E. M. Wakefield and Dr G. R. Bisby took part.

E. C. Large. Sketches of the growth of the potato from planting to harvest, with special reference to humus deficiency.

Two plots of TSA Great Scot from Dartmoor were cultivated at Pinhoe, Devon, in 1941. One plot, in an open garden, received a thin layer of well-rotted compost at tuber level; the other, in an adjoining grass field, dug in February, had a layer of turf buried one spit deep. Both plots received a dressing of superphosphate at 4 cwt. per acre and of sulphate of potash at 2 cwt. per acre. The potatoes were planted on Sunday, 27 April, and on successive Sundays through the growing period, representative plants, complete with their underground parts in situ, were sketched at half-linear scale. This provided a strip cartoon which recorded the effects upon the growth of the plants of the cold dry spring, the rain and fine growing weather in June, and the succeeding long dry spell followed by a wet August. Bulking of the tubers began, in the garden plot, about 6 July, when the green surface exposed to light by each plant was about 34 sq. ft. and the root length was over 100 ft. No symptoms of Leaf Roll or other virus disease ever appeared among the Devon plants. Spots of Early Blight (*Alternaria Solani*) were observed on 20 July. Late Blight (*Phytophthora infestans*) appeared on the plants in the garden plot on 17 August. The spread of Blight at BMS Grade 2 on Great Scot was prevented by spraying with Bouisol at 1 fd. oz. per gallon, i.e. with a copper oxychloride spray fluid containing only one-half the copper present in 1% Bordeaux Mixture. Spraying was repeated a fortnight later; the Blight did not reach BMS Grade 3 until 14 September. The possible critical importance of BMS Grade 2, as the last stage at which spraying can be effective, was borne out by other field experiments.

Symptoms of potash and manganese deficiency first appeared on the *field plot* only, during rain following drought, on 20 July. The deficiency effects progressed very rapidly after 3 August, and by 24 August the productive life of the plants was over. The total crop averaged 1½ lb. per plant, or about 10 tons per acre. No symptoms of mineral deficiency were ever apparent among the plants in the garden

plot, and tuber development continued until 14 September, when uniform autumnal yellowing of the foliage set in. The crop averaged $3\frac{1}{2}$ lb. or 23·3 tons per acre. The soil at tuber level in both plots was analysed after the crops were lifted: the potash figures were in close agreement, and apart from a materially higher phosphate figure for the garden plot and slightly higher *p*H, the principal difference was in the humus content of the soil. This, with evidence obtained when sketching the root systems, suggested that the deficiency effects on the *field plot* were not due to deficiency of mineral salts in the soil, but to lack of sufficient moisture-retaining humus at root level, without which, during the summer drought, the plants were unable to avail themselves of mineral salts.

W. A. Roach. The use of plant injection in plant pathology

Parts of a plant may each be injected with a different liquid, the effects of which can be observed by comparing adjacent treated and untreated regions. Parts as small as a single interveinal area of a leaf and as large as a main branch of a tree may be so studied. Such methods may be used for studying both mineral deficiency diseases and host-parasite relationships. Whole plants may be injected for similar purposes or for curing disease.

These methods are now widely used for the diagnosis of mineral deficiency and are applicable to most plants of commercial importance. The deficiency is made good by the simplest effective method, e.g. by application to the soil whenever this is effective; or by spraying or dusting; or when other methods are less effective, large plants such as trees may be cured commercially by injection. I co-operated in curing apple trees of iron deficiency by injection in this country, peach trees of manganese deficiency in South Africa, both on a commercial scale; and cherry trees in this country have been cured on a small scale of a commercially serious manganese deficiency. Useless barren trees of all three kinds were brought into full bearing.

Although a diagnosis has been made by the interveinal method in two days, a week or a fortnight is usually necessary. The leaf-stalk method is the most generally useful for diagnosis; by it certain leaves are treated on one side of the midrib and left untreated on the other.

Three examples may be given from my own work of host-parasite relationship being affected by injection. The treatment of apple shoots with sodium thiosulphate has controlled mildew (*Podosphaera leucotricha*). Injection of whole apple trees with dipotassium hydrogen phosphate and urea has controlled a severe combined infestation of leaf hopper (Jassidae) and red spider (*Oligonychus ulmi* Koch.). Plum trees have been cured at least temporarily of silver leaf (*Stereum purpureum*) by injection with a disinfectant or a nutrient.

G. Samuel. Some reflexions on the control of virus diseases.